Engineering Library

"THE ENGINEER," SEPTEMBER 26, 1930

With METALLURGICAL SUPPLEMENT.

# The Engineer.

Established 1856.

Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 28, ESSEX ST., STRAND, LONDON, W.C. 2.

VOL. CL.—No. 3898] LONDON: FRIDAY EVENING, SEPTEMBER 26, 1930 [PRICE {WITH SUPPLEMENT} ONE SHILLING BY INLAND POST 1s. 3d.

OCT 8 1930

## PUBLIC NOTICES

HEATING.

**The Commissioners of** His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Tuesday, 14th October, 1930, for LOW-PRESSURE HOT-WATER HEATING at :

(a) The Post Office, &c., Braintree.
(b) the Telephone Exchange, Ashton-under-Lyne.

Drawings, specification, copies of the conditions and forms of contract, bills of quantities, and forms for Tender, may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea in each case. (Cheques payable to The Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 5821

**Air Ministry Aeron-** NAUTICAL INSPECTION DIRECTORATE.

A VACANCY exists for an AERONAUTICAL EXAMINER. Candidates should possess good general and technical education, thorough engineering training, including some experience in testing metallic materials, thorough knowledge of construction and testing of aircraft engines and their accessories. Preference given to ex-Service men.

Salary £175-£10-£250 per annum plus Civil Service bonus (aggregate at present £250-£353.)

Apply, giving full particulars, SECRETARY (I.E.1), Air Ministry, Kingsway, W.C. 2, not later than 3rd October, 1930. 5788

**Civil Service Com-** MISSION.

FORTHCOMING EXAMINATION.

PROBATIONARY INSPECTORS in the Engineering Department of the Post Office (17-23, with extension for service in H.M. Forces).

Regulations and particulars, together with the forms on which applications must be made, will be sent in response to requests (preferably by postcard), addressed to the SECRETARY, CIVIL SERVICE COMMISSION, Burlington-gardens, London, W. 1, GIVING THE TITLE OF THE SITUATION. The latest date for the receipt of application forms is 23rd October, 1930. 5647

UNIVERSITY OF LONDON.

**Goldsmiths' College, New Cross,** LONDON, S.E. 14.

A COURSE of 52 LECTURES on

ENGINEERING ECONOMICS

will be given by T. H. BURNHAM, B.Sc., B. Com., A.M.I.M.E., on MONDAYS and WEDNESDAYS, from 7.30 to 9.30 p.m., covering the Syllabus of Section C of the Examination for Associate Membership of the Institution of Mechanical Engineers, and the City and Guilds' Final Examination in Mechanical Engineers' Estimates and Specifications.

Commencing MONDAY, 13th OCTOBER, 1930, extending to WEDNESDAY, 29th APRIL, 1931.

Mondays, Part I.: GENERAL and COMMERCIAL.

Wednesdays, Part II.: INDUSTRIAL.

Fees: 10s. per Session for one evening per week.
15s. per Session for two evenings per week.

Entries will be accepted for either or both evenings.

The INAUGURAL LECTURE will be given on THURSDAY, 9TH OCTOBER, at 8 p.m., by ENG. VICE-ADMIRAL SIR GEORGE GOODWIN, K.C.B., LL.D., CHAIRMAN: SIR JOHN PRESTIGE.

Admission free.

For further information apply to THE WARDEN, Goldsmiths' College, New Cross, London, S.E. 14. 5811

**Robert Gordon's Technical** COLLEGE, ABERDEEN.

(CENTRAL INSTITUTION.)

The Court of the University of Aberdeen and the Governors of Robert Gordon's Colleges co-operate in the provision of courses leading to the Pass and Honours Degrees of B.Sc. (Engineering) of the University and to the Associateship of the Colleges in the Departments of :—

CIVIL ENGINEERING,
MECHANICAL ENGINEERING,
ELECTRICAL ENGINEERING.

Full-time Day Courses in Mechanical and Electrical Engineering lead to the Higher National Diplomas in these subjects.

Prospectuses forwarded gratis on application to the SECRETARY and REGISTRAR, Robert Gordon's Colleges, Aberdeen. P56

TO CONTRACTORS.

**County Borough of Wallasey.** SEACOMBE FERRY IMPROVEMENTS.

CONTRACT No. 3.

The Corporation of the County Borough of Wallasey are prepared to receive TENDERS for the CONSTRUCTION at Seacombe, in the County Borough of Wallasey, of the STEELWORK in connection with the NEW BOOKING HALL, a NEW SHELTER on the LANDING-STAGE, and WIDENING of the SOUTH PASSENGER BRIDGE, together with works incidental thereto.

The contract drawings and specification may be seen at the offices of the Engineers, Sir John Wolfe Barry and Partners, Dartmouth House, 2, Queen Anne's-gate, Westminster, S.W. 1, or at the office of the General Manager, Ferries Department, Seacombe, on and after Monday, 22nd September, between the hours of Eleven and Four, and copies of the drawings and specification, together with a schedule of quantities and form of Tender, may be obtained at either of the above offices upon payment of 5 (Five) Guineas. This sum will be repaid by the Corporation upon receipt of a bona fide Tender, accompanied by the specification and drawings, which are to be returned with the Tender.

Tenders, endorsed "Tender for Seacombe Ferry Improvements, Contract No. 3," must be delivered under seal at the office of the Town Clerk, Town Hall, Wallasey, Cheshire, on or before Noon on 25th October, 1930.

The Corporation do not bind themselves to accept the lowest or any Tender.

GEO. LIVSEY,
Town Clerk.

Town Hall,
Wallasey,
18th September, 1930. 5795

## The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.
ARRANGED FOR CARD INDEXING.

The Metallurgist.
THE ENGINEER, 26 - 9 - 30.

The Shishkoff Hydro-Thermal Tidal Power System. (P. 330)
THE ENGINEER, 26 - 9 - 30.

The British Association—No. III. (P. 333)
THE ENGINEER, 26 - 9 - 30.

The Building Exhibition at Olympia. (P. 347)
THE ENGINEER, 26 - 9 - 30.

International Agricultural Tractor Trials No. II. (P. 337)
THE ENGINEER, 26 - 9 - 30.

The Iron and Steel Institute—No. II. (P. 344)
THE ENGINEER, 26 - 9 - 30.

The Institute of Metals—No. III. (P. 335)
THE ENGINEER, 26 - 9 - 30.

River Gunboats for the Colombian Government. (P. 350)
THE ENGINEER, 26 - 9 - 30.

The Sampling of Coal. (P. 343)
THE ENGINEER, 26 - 9 - 30.

A New Dionic Water Tester. (P. 350)
THE ENGINEER, 26 - 9 - 30.

## INDEX TO ADVERTISEMENTS, PAGE 79.

## PUBLIC NOTICES

**County Borough of Smethwick.** LAW COURTS.

The Watch Committee invite firms of Heating Engineers to submit SCHEMES and TENDERS for the HEATING of the NEW LAW COURTS now in course of erection at Crocketts-lane, Smethwick.

The Committee is prepared to consider any system of Heating, e.g.:—

Coke-fired Hot Water System.
Oil-fired Hot Water System.
Gas-fired Hot Water System.
Electric System.

Further details and necessary plans can be obtained from the BOROUGH ENGINEER and SURVEYOR, Council House, Smethwick.

The Council does not bind itself to accept the lowest or any Tender.

September, 1930. 5805

**County of London.**

The London County Council invites TENDERS for the SUPPLY and INSTALLATION at the Greenwich Power Station of :—

(A) TWO 20,000-kW STEAM TURBO-ALTERNATORS with FEED HEATERS, FEED PUMPS, &c.;
(B) CONDENSING PLANT, AIR EXTRACTION PLANT, &c.

The specification, drawings, form of Tender, &c., may be obtained from the General Manager of Tramways, Tramways Offices, 23, Belvedere-road, S.E. 1, upon payment of £3. This amount will be repayable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application and the contract documents may be inspected before the payment of the fee.

The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract and in "The London County Council Gazette."

No Tender received by the Clerk of the Council, the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 3rd November, 1930, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

MONTAGU H. COX,
5803 Clerk of the London County Council.

## PUBLIC NOTICES

**Corporation of Cheltenham.** WATER DEPARTMENT.

TENDERS FOR PUMPING MACHINERY.

TENDERS are INVITED for the SUPPLY and ERECTION of LOW and HIGH-LIFT PUMPING MACHINERY for Raising Water at the rate of 80,000 gallons per hour from the River Severn at Tewkesbury to the sand filters on a site near the river and after filtration delivering into the Pumping Mains to Cheltenham against a head of 560ft. The present pumps are steam-driven, but electric or other power will be considered.

Further information may be obtained from the undersigned, to whom proposals are to be submitted not later than 31st October, 1930.

The lowest or any Tender will not necessarily be accepted.

J. S. PICKERING, M. Inst. C.E.,
Water Engineer.

Municipal Offices, Cheltenham,
17th September, 1930. 5777

**Surrey County Council.** HIGHWAYS AND BRIDGES DEPARTMENT.

GUILDFORD BY-PASS.

SECTION No. 2.

TENDERS are INVITED for the SUPPLY of the following PLANT :—

(1) NEW or SECOND-HAND ¾-Yard BUCKET STEAM NAVVY EXCAVATOR, mounted on caterpillar track.

(2) NEW or SECOND-HAND LOCOMOTIVE, Steam or Diesel, 2ft. gauge, capable of working on 1 in 15 gradient.

Tenders should be made on the prescribed form, which may be obtained from the County Engineer, County Hall, Kingston-on-Thames, and should be returned to him not later than first post on Saturday, 4th October.

The Council do not bind themselves to accept the lowest or any Tender.

DUDLEY AUKLAND,
Clerk of the County Council,
County Hall, Kingston-on-Thames.

18th September, 1930. 5797

## PUBLIC NOTICES

**Administrative County of** LONDON.

SOUTH CIRCULAR ROAD.

BRIDGE CARRYING SOUTHERN RAILWAY OVER WESTHORNE-AVENUE.

The London County Council invites TENDERS for the CONSTRUCTION of a NEW BRIDGE to carry the Southern Railway (Bexley Heath line) over Westhorne-avenue (South Circular Road), in the Metropolitan Borough of Woolwich. The contract will include the Supply and Erection of Temporary Trestles and Steel Girders with Rail Timbers required to carry the running lines during the construction of the permanent work; the Construction of the Abutments and the Supply, Erection and Painting of the Steel Superstructure, and the Concreting and Asphalting of the Deck of the New Bridge.

The form of Tender, specification, bill of quantities and drawings may be obtained, on and after 26th September, 1930, on application to the Chief Engineer, Old County Hall, Spring-gardens, S.W. 1, upon payment of £5 by cheque, draft or money order to the order of the London County Council. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the contract documents may be inspected before payment of the fee.

Remittances by post should be addressed to the Chief Engineer, Old County Hall, Spring-gardens, S.W. 1. Personal enquiries at Room 9a, No. 3, Warwick House-street, Cockspur-street, S.W. 1.

The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract and in "The London County Council Gazette."

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge-road, S.E. 1, after 4 p.m. on Monday, 20th October, 1930, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

MONTAGU H. COX,
5809 Clerk of the London County Council.

**Metropolitan Water Board.** TENDERS FOR THE MANUFACTURE, DELIVERY AND FIXING OF A COAL-HANDLING PLANT, &c., AT SURBITON PUMPING STATION.

The Metropolitan Water Board invite TENDERS for the MANUFACTURE, DELIVERY and FIXING of a COAL-HANDLING PLANT, &c., at their Surbiton Pumping Station, Portsmouth-road, Surbiton, Surrey.

Forms of Tender, conditions of contract and specification and drawings may be inspected without payment of a fee at the Offices of the Board, Chief Engineer's Department (Room 173), on and after Friday, 26th September, 1930.

Contractors desirous of tendering may obtain the necessary documents from the Chief Engineer on production of an official receipt for the sum of Three Guineas, which must be deposited with the Accountant to the Board and which will be returned on receipt of a bona fide Tender, accompanied by all the above named documents and drawings. Such payments and applications must be made between the hours of 10 a.m. and 4 p.m. (Saturdays, 10 a.m. and 12 noon). Cheques must be made payable to the Metropolitan Water Board and not to individuals.

Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board and endorsed "Tender for Coal-handling Plant, Surbiton," must be delivered at the Offices of the Board (Room 122) not later than 11 a.m. on Tuesday, 21st October, 1930.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery avenue, E.C. 1,
22nd September, 1930. 5801

**Port of Bristol Authority.** CONSTRUCTION OF REINFORCED CONCRETE JETTY AND DOLPHINS, ROYAL EDWARD DOCK, AVONMOUTH.

The Port of Bristol Authority expects shortly to invite TENDERS for the CONSTRUCTION of a REINFORCED CONCRETE JETTY and THREE REINFORCED CONCRETE DOLPHINS in the Oil Basin of the Royal Edward Dock, Avonmouth. The Work also includes the REMOVAL and DEPOSITING over Spoil Lands of the EXCAVATED MATERIAL in connection with these Works.

Further information regarding the scheme will be published in this Journal on Friday, the 3rd October, 1930.

In the meantime, firms may, on making application, have an opportunity of inspecting the drawings at the Docks Engineer's Office, Avonmouth.

THOMAS A. PEACE,
Chief Engineer,
Port of Bristol Authority.

Chief Engineer's Office,
Avonmouth Docks, Bristol,
26th September, 1930. 5818

**PUBLIC NOTICES (continued) Page 2.**
**SITUATIONS OPEN Page 2.**
**SITUATIONS WANTED, Page 2.**
**AUCTIONS, Page 80.**
**BUSINESSES and PREMISES (For Sale, etc.). Page 80.**
**MISCELLANEOUS, Page 4.**
**EDUCATIONAL, Page 4.**
**MACHINERY, &c., WANTED, Page 80.**
**PARTNERSHIPS, Page 4.**
**PATENTS, Page 4.**
**FOR SALE, Page 4.**
**AGENCIES, Page 3.**
**WORK WANTED, Page 80.**
**FOR HIRE, Page 4.**

*For Advertisement Rates see Leader Page.*

## PUBLIC NOTICES

TO CONTRACTORS.

### Shoreham Harbour Trustees.

NEW LOCK AND DIVERSION OF TOWING PATH.

The Shoreham Harbour Trustees invite TENDERS from responsible persons or firms willing to enter into a contract for the CONSTRUCTION of a NEW LOCK at Shoreham Harbour adjacent to the existing Lock, together with a DIVERSION of the TOWING PATH east of the Lock and other ancillary WORKS.

Copies of the drawings relating to the works may be seen at the Harbour Master's Office, Southwick, Sussex, or at the Offices of the Consulting Engineers, Messrs. Lewis and Lewis, 15, Victoria street, Westminster, S.W. 1, from whom copies of the contract documents may be obtained on or after October 1st, 1930, upon payment of a deposit of £1, which will be returned after the receipt of a bona fide Tender with the bill of quantities fully priced out. Sun prints of the drawings may also be obtained from the Engineers at a cost of 10s. the set.

The works are to be carried out as an approved scheme for the relief of unemployment, and the contractors will have to fulfil the conditions of employment of labour as laid down by the Unemployment Grants Committee in their Circular U.G. 25. A percentage of the men employed are to be taken from distressed areas. Local accommodation for these men will be available.

Tenders are to be made out on the form supplied and are to be enclosed, together with the signed copy of the general conditions, specification and priced bill of quantities, in a sealed envelope, endorsed outside "Tender for Lock" and bearing the name and address of the tenderer. The sealed envelope is to be enclosed in an outer envelope, addressed to the Clerk to the Trustees, and delivered to him at the Harbour Offices, Southwick, Brighton, on or before the 22nd day of October, 1930.

The Trustees do not bind themselves to accept the lowest or any Tender.

ARTHUR R. T. WILLIAMS, Commander R.N., Clerk to the Trustees.

Harbour Offices,
Southwick, Brighton,
September 23rd, 1930. 5806

### Shoreham Harbour Trustees.

RESIDENT ENGINEER.

The Shoreham Harbour Trustees REQUIRE the SERVICES of a fully qualified MAN to act as RESIDENT ENGINEER in charge of the Construction of a New Lock and Diversion of Towing Path at Shoreham Harbour, under the direction of the Consulting Engineers, Messrs. Lewis and Lewis, 15, Victoria-street, Westminster, S.W. 1.

Applicants should not be under 35 years nor over 55 years of age and must have had experience of large constructional works. Applications, giving the candidates' full experience, accompanied by copies of testimonials and stating salary required, are to be sent to me at the Harbour Offices, Southwick, Brighton, not later than October 22nd, 1930, enclosed in a sealed envelope, endorsed on the outside "Resident Engineer."

ARTHUR R. T. WILLIAMS, Commander R.N., Clerk to the Trustees.

Harbour Offices,
Southwick, Brighton,
September 23rd, 1930. 5806*

### The Assam-Bengal Railway

COMPANY, LIMITED.
PRODUCTION ENGINEER.

REQUIRED, a PRODUCTION ENGINEER for the Locomotive and Carriage and Wagon Repair Shops of the above Railway Company in India. Age about 28 to 35 years.

QUALIFICATIONS:—

(1) A sound knowledge of Modern Production Methods with special training in Machine Shop Practice. Capable of introducing new production methods in large engineering works.
(2) Good Designer of Jigs and Tools and Fixtures, and able to make Tool Lay-outs for all classes of machine shop work.
(3) A sound knowledge of Planning and Rate-fixing. Capable of Laying-out Detailed Manufacturing Operations, Estimating Times and Detailing the Types of Machines in which parts are to be manufactured.
(4) Must be prepared to Supervise Demonstrations of Operations on all classes of machine tools used in a large machine shop.
(5) A good knowledge of Inspection Methods and Gauging System essential.
(6) The candidate selected should have held the position of either production engineer, head planner and rate-fixer or machine shop manager in a large engineering works.
(7) Locomotive or Carriage and Wagon Experience essential.

SALARY.—Rs. 375 to 975 per calendar month (plus Overseas Allowance), according to age and qualifications.

TERMS.—A three years' agreement in the first instance and first-class free passage to India. The selected candidate will be required to pass a strict medical examination.

Particulars of candidates' careers, giving in chronological order (with dates) details of general and technical education, where apprenticeship or pupilage was served, and subsequent experience, and stating age and whether married or single, accompanied by copies only of testimonials, should be addressed to the undersigned. Applications will be considered as received.

By Order of the Board,
M. A. RICHARDSON,
Actg. Secretary.

18th September, 1930.
80, Bishopsgate, E.C. 2. 5794

## SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

ASSISTANT MANAGER REQUIRED whose Principal duties will be the Preparation of Estimates and Technical Correspondence; trained engineer, crane experience essential. Applications, in own handwriting, stating age, training, experience, salary required, with copies only of testimonials.—Address, P305, The Engineer Office. P305 A

CHIEF ASSISTANT REQUIRED IMMEDIATLEY by Consulting Engineer in the Far East. Expert knowledge and experience in Designing, Writing Specifications and Supervision of large modern Hot Water, Steam Heating and Ventilating Systems of all types essential. Excellent prospects for the right man. —Write, stating age, and full particulars of experience, P297, The Engineer Office. P297 A

ENGINEER FOR WORKS.—Must be Fully Experienced in Modern Steam Plant and have a knowledge of A.C. Electrical Installation. State age, salary required and experience.—Address, 5831, The Engineer Office. 5831 A

ENGINEER WANTED for Chemical Works in London. Thorough technical and practical training necessary. Must have held similar position. Write, giving full particulars of career and state salary required.
Address, 5826, The Engineer Office. 5826 A

QUALIFIED CHEMIST REQUIRED for Laboratory Work. Experience in Colloids desirable. London district. Write, giving full particulars of qualifications and state salary required.—Address, 5827, The Engineer Office. 5827 A

QUALIFIED CIVIL ENGINEER REQUIRED as Tutor by Correspondence College. Permanency. State qualifications and salary required.—Address, P280, The Engineer Office. P280 A

REPRESENTATIVE FOR INDIA.—WANTED, YOUNG MAN, energetic, with good education and address, and engineering experience. Single man preferred.—Apply by letter, giving full particulars, to SECRETARY, Samuel Osborn and Co., Ltd., Clyde Steel Works, Sheffield. 5834 A


# ARNOLD BOOKS

*New (Fifth) Edition. Ready Oct. 16. Revised and Re-set.*

## HYDRAULICS.

**For Engineers and Engineering Students.**

By F. C. LEA, D.Sc., M. Inst. C.E. Professor of Mechanical Engineering in the University of Sheffield. xii + 760 pages, 545 diagrams. **21s.** net.

The present revision, bringing this important work right up to date, both theoretically and practically, has necessitated the addition of some 150 pages of new matter and 150 diagrams.

**STEAM POWER.** By W. E. DALBY, F.R.S., M. Inst. C.E., M.I. Min. E., University Professor of Engineering, City and Guilds (Engineering) College. SECOND EDITION. xvi + 760 pages, 250 diagrams. **25s** net.

**ELECTRIC TRAINS.** By R. E. DICKINSON, B.Sc., A.M. Inst. C.E., A.M.I.E.E., Works Manager, Electric Train Repair Shops, New South Wales Government Railways. xii + 292 pages, 139 diagrams. **16s.** net.

**THE ECONOMICS OF RAIL TRANSPORT IN GREAT BRITAIN.** By C. E. R. SHERRINGTON, M.A., A.M. Inst. T., Lecturer on Transport and Secretary of the Railway Research Service, at the London School of Economics. In Two Volumes, obtainable separately. VOLUME I. History and Development. xii + 283 pages. **12s. 6d.** net. VOLUME II. Rates and Service. xii + 332 pages. **12s. 6d.** net.

**THE THEORY OF MACHINES.** By R. F. McKAY, M.Sc., A.M. Inst. C.E., M.I. Mech. E. viii + 440 pages, 407 diagrams. **21s.** net.

**THE STRENGTH OF MATERIALS.** **A Treatise on the Theory of Stress Calculations for Engineers.** By JOHN CASE, M.A., F.R.Ae.S., Lecturer in Applied Mechanics at the Royal Naval Engineering College, Keyham. viii + 552 pages, with 398 diagrams. **30s.** net.

LONDON EDWARD ARNOLD & CO. 41 & 43, MADDOX ST., W.


## SITUATIONS OPEN (continued)

REQUIRED FOR WEST AFRICA.—MECHANICAL ENGINEER to Take Charge Running Plant. Must be experienced Maintenance and Repair, Steam and Electrical. Age 25/35. Salary £450/£500 p.a. Applicants to state age, qualifications and experience in detail.
Address, 5833, The Engineer Office. 5833 A

SALES ENGINEER REQUIRED, Age 21 to 25. Sound technical training, preferably in Steam Engineering. Previous selling experience not essential.—Address, 5825, The Engineer Office. 5825 A

SALES MANAGER FOR MARINE ENGINE DEPARTMENT.—PETTERS LIMITED, Oil Engine Manufacturers, Yeovil, have a VACANCY for the above.—Applications, which should be addressed to the SECRETARY, are invited from gentlemen of some experience in the Marine Oil Engine Trade, and should state age, qualifications, and salary required. 5799 A

DETAILING DRAUGHTSMAN for Structural Steelwork. State experience and salary required.—JAMES SMITH, Hamworthy, Poole, Dorset. 5819 A

REQUIRED, a TRACER (Male), Commencing wages 25s. per week plus Civil Service Bonus; total 41s. 3d. per week.—Write, stating experience, to the COMMANDANT, Experimental Station, Porton, nr. Salisbury, Wilts. 5804 A

TRANSFORMER DRAUGHTSMEN REQUIRED, preferably experienced.—Apply, giving age, full particulars and salary required, to ENGLISH ELECTRIC CO., Ltd., Stafford. 5752 A

FOREMAN BLACKSMITH REQUIRED by Manchester Firm of General Engineers.

Applicants must have received their training in a large Works and must have previously held a position as Foreman.

Good opportunity to man accustomed to up-to-date forge methods. Age not to exceed 45 years.
Address, 5824, The Engineer Office. 5824 A

FOREMAN REQUIRED for GRINDING PLANT in London, to look after about 20 men. Must have thorough knowledge of the working of Electric Motors and also good experience in engineering.
State age, experience, and salary required.
Address, P283, The Engineer Office. P283 A

FOREMAN REQUIRED for Steel Foundry, Capable of Producing 100 Tons of Light and Medium Castings per week. Must be thoroughly acquainted with Machine Moulding Practice. Good organiser and strict disciplinarian. One used to green sand and dry sand moulding, and capable of fixing piecework prices.

Unless thoroughly experienced in all these branches applications will not be considered.

Address, in confidence, stating age, experience and salary expected, 5783, The Engineer Office. 5783 A

## SITUATIONS OPEN (continued)

FOREMAN WANTED, with Thorough Knowledge of latest methods in production of Light Plating and Structural Work.
Address, with full particulars of experience, age, and salary required, 5798, The Engineer Office. 5798 A

## SITUATIONS WANTED

ADVERTISER, Age 37, SEEKS POST as ENGINEER-MANAGER or similar ADMINISTRATIVE POSITION. Sound Mech.-elect. experience, practical and technical, modern manufacturing methods, and organising of same, overhaul of designs for costs reduction; successful handling labour; initiative and personality. Can really produce results. Excellent references. —Address, P294, The Engineer Office. P294 B

ADVERTISER, B.Sc., Student, Wishing to Qualify for A.M.I.C.E. and A.M.I. Struct. E., REQUIRES POSITION as Apprentice or Assistant in Civil or Structural Engineers' concern. Premium offered.—Address, P289, The Engineer Office. P289 B

A.M.I. MECH. E., Experienced in the Supervision at makers' works of structural steel work, storage tanks for all purposes, piping of all kinds, railway rolling stock, &c.—Address, P243, The Engineer Office. P243 B

A.M.I.C.E., A.M.I. Mech. E., 39, with Railway works, D.O., running sheds, automobile, tramway, general engineering and public works experience, many years' successful control of staff, DESIRES CHANGE.
Address, P264, The Engineer Office. P264 B

CHEAPER PRODUCTION, Elimination of Oncosts increased output per unit. Experienced and able ENGINEER OFFERS SERVICES.—Address, P277, The Engineer Office. P277 B

COMPETENT EXECUTIVE, Experienced in the organisation and establishment of industries and works on profitable production bases, DESIRES OFFER; exceptional record.—Address, P7186, The Engineer Office. P7186 B

CONTINENTAL MACHINE TOOL MARKET. ADVERTISER, British, 32 years, export sales manager, large continental machinery dealers, 10 years' selling experience Germany, France, Holland, Belgium, SEEKS ENGAGEMENT, British Firm.—Address, 5823, The Engineer Office. 5823 B

ENGINEER, of Proved Inventive Ability Engaged on experimental investigation, DESIRES a CHANGE.—Address, P287, The Engineer Office. P287 B


# YARROW HOME and HOSPITAL
## FOR CHILDREN
## BROADSTAIRS.

**For the Early & Preventive Treatment of Disease & Convalescence after illness.**

*Managed by a Committee appointed by the Council of the Institution of Civil Engineers.*

The Hospital is intended for the children of members of the Institution of Civil Engineers, the children of architects, artists, authors, clergymen, members of the medical, legal and other professions, members of scientific societies, officers of the Navy, Army, and Royal Air Force, officers of the Merchant Navy, schoolmasters and university professors.

**Accommodation is provided for 50 Boys between the ages of 4 and 12 years, and 50 Girls between the ages of 4 and 14 years. In special cases the age limits may be raised to 14 for Boys and 16 for Girls.**

**Fee 21/- per week, or as may be arranged, and travelling expenses.**

*Particulars can be obtained from the Secretary:—*
**116, Victoria Street, Westminster, LONDON, S.W. 1.**


## SITUATIONS WANTED (continued)

COSTS.—Middle-aged MAN, Thoroughly Experienced and used to big jobs in works organisation, cost and works accountancy, stores control, rate-fixing, control of labour and wages DESIRES RESPONSIBLE POSITION, economic methods.—Address, P308, The Engineer Office. P308 B

ENGINEER (25), 5 Years Machine Tools, 3 Years drawing-office, 12 months travelling and demonstrating, REQUIRES POSITION as ASST. MAINTENANCE ENGINEER or CHIEF of MOTOR FLEET, &c.—Address, P309, The Engineer Office. P309 B

ENGINEER (24) DESIRES POST with Consulting Engineer, Constructional Engineers, or Civil Engineering or Building Contractors. Good experience D.O. and outdoor supervision; steel-frame buildings, railway bridges, and R.C. structures.—Address, P288 The Engineer Office. P288 B

FOUNDRY MANAGER DESIRES CHANGE. Sound experience refrigeration, electrical, laundry, hydraulic, machine tool, general engineer's castings up to 20 tons; highest references; offers invited; confidential.—Address, P302, The Engineer Office. P302 B

GENERAL MANAGER, Engineering, Charge of 3000 men, 150 staff, engaged on armaments, hydraulic, general hydro-electric, small tools, mining and road machinery, AVAILABLE for NEW APPOINTMENT. —Address, P265, The Engineer Office. P265 B

GENTLEMAN of Proved Ability, with Sound Experience of factory construction and maintenance, combustion, electrical machinery, at present engaged as superintendent engineer on large chemical plant, SEEKS FRESH APPOINTMENT with responsibility. Age 31.—Address, P301, The Engineer Office. P301 B

MAJOR H. O. WRAITH, M.I. Mech. E., M.I.E.E., formerly of Doxfords and of Vickers, Ltd., is about to terminate engagement with Chance Brothers Lighthouse Works, and OFFERS his SERVICES in an Administrative Engineering Capacity to a sound concern.
Would consider establishing new works in England or in a tariff-walled country abroad for a British firm.
Address, P298, The Engineer Office. P298 B

MECH. ENGR. (29), Passed A.M.I. Mech. E. Exam., factory erection and maintenance eng., good steam, hydraulic, air conditioning and electrical exp., SEEKS CHANGE in responsible post.—Address, P307, The Engineer Office. P307 B

MECHANICAL ENGINEER, with Sound Practical technical and commercial experience, at present shift maintenance engineer on large semi-chemical plant, DESIRES POSITION as PLANT MAINTENANCE ENGINEER or other interesting work. Not afraid of hard work and long hours.—Address, P296, The Engineer Office. P296 B

REPRESENTATIVE.—Fluent French, Knowledge of German, Assoc. M. Inst. C.E., 1st Class B.O.T. Marine Engineering, 17 years engineering (10 ashore, 7 at sea), 4 YEARS' SELLING EXPERIENCE, available end October.—Address, P286, The Engineer Office. P286 B

DRAUGHTSMAN, Age 26 Years, Structural detailer, knowledge theory and design. Experience large storage tanks, welded and rivetted pipes, cast ironwork, &c., DESIRES PROGRESSIVE SITUATION. At present with prominent bridge and constructional engineers.—Address, P300, The Engineer Office. P300 B

## AGENCIES

ADDITIONAL AGENCY REQUIRED for London by Engineer Salesman; first-class connection with Oil and Mining Companies.
Address, P293, The Engineer Office. P293 D

ARGENTINE.—Well-known ENGINEERING FIRM, having branch in Buenos Aires, with offices in central position in the city, employing five or six travellers, also sub-agents in all important towns in the Argentine and adjacent countries, WISH to REPRESENT reputable FIRMS in all classes of Machinery and Engineering Products.

A large stand has been booked for the British Empire Trade Exhibition, Buenos Aires, 1931.
Address, 5829, The Engineer Office. 5829 D

CHARTERED ENGINEER, Having Office in Westminster and good connection amongst engineers, dock authorities and public works contractors, DESIRES to REPRESENT a first-class FIRM, or WOULD ACT as TECHNICAL REPRESENTATIVE. —Address, P284, The Engineer Office. P284 D

ELECTRIC OVERHEAD TRAVELLING CRANES, LIFTING BLOCKS, RUNWAYS, &c.—AGENCY REQUIRED for Birmingham and Midlands.—Address, P272, The Engineer Office. P272 D

ENERGETIC AGENTS WANTED in All Districts except London to represent on commission up-to-date firm of Brassfounders and Machinists. No stock lines or plumbers' fittings.—Address, 5761, The Engineer Office. 5761 D

ENGINEER, with Extensive Connection in Lancashire, and North Cheshire, is DESIROUS of TAKING UP a further AGENCY; would consider a new speciality if terms suitable.—Address, Box 251, Wheeler's Advertising Agency, Manchester. P299 D

ENGINEERS, with London Office, REQUIRE SOLE AGENCY for London and South on commission basis only. Good connection among engineers, chemical works, &c.—Address, P304, The Engineer Office. P304 D

EXPERIENCED ENGINEER, A.M.I.C.E., M.I.M.E., DESIRES LONDON AGENCY Air Compressors or other machinery.—"AGENCY," 53, Victoria-street, Westminster, S.W. 1. P306 D

## GERMANY.

ENGINEERING OFFICE, Residence Berlin, with good connections to the whole industry, SEEKS REPRESENTATION of foreign undertakings in development, sale and patent affairs.
Offers under A.P.D., 150, Ala Haasenstein and Vogler, Berlin, W. 35. 5792 D

LONDON FIRM of ENGINEERS, with Large Clientele amongst Railways (home and foreign), Tramways and general Engineering, and users of Engineering Material, wish to take up REPRESENTATION of First-class Firm. Intensive circularising and canvassing propaganda always in force, and calls made by cars.—Write, T. C., c/o J. W. Vickers and Co., Ltd., 24, Austin Friars, E.C. 2. 5810 D

MANUFACTURERS have OPENING for Well-established AGENTS with connections amongst Steam Users in principal commercial centres where not already represented. A splendid proposition. —SMITH'S (NON-INCRUSTA), Ltd., Tennyson-place, Bradford, Yorks. 5787 D

SALES REPRESENTATIVES, Having Good Connection in the London district, REQUIRED by Firm of Boilermakers in Midlands. Preference given to firm having office in Kingsway or Westminster district.—Address, stating full particulars, 5830, The Engineer Office. 5830 D

**For continuation of Small Advertisements see page 4.**

# A Seven-Day Journal

## Gold Mining in Great Britain.

THAT native gold exists in certain parts of Great Britain there is not the slightest doubt. In early times it was recovered in Scotland in sufficient quantities to make its use as coinage practicable. From time to time since then traces of it have been found, for example, in Argyllshire, and efforts have been made to work them. It would appear, however, that under modern conditions it is hopelessly unprofitable to mine British gold. That at least has been the experience of all those who, in recent times, have set out, with high hopes, to recover the precious metal in this country. It is announced this week that the Mines Department has appointed Professor Henry Louis to hold an inquiry into the possibility of developing the production of gold and other metals in Merionethshire. The inquiry is to open at Dolgelly on October 7th, and already active steps are being taken in the Barmouth district to collect evidence to lay before Professor Louis.

## A New Television Broadcasting Station.

A NEW television broadcasting station is being built near Hendon and is to be controlled by the Baird Company. For some time past it has been felt that experimenters have insufficient facilities for enabling them to follow the progress of the new science, and the promoters of Baird television have, therefore, decided that in future practically an all-day service shall be provided by the new station, which will transmit on two wavelengths, namely 49½ m. and 155 m. The power of the station will be 900 watts. At the outset the transmissions will be of an experimental nature, and unless special leave is granted by the Government it will be impossible to transmit sound and images simultaneously, as is done at Brookman's Park, as the B.B.C. has the sole right of transmitting sound for entertainment purposes. The two wavelengths have been allotted to the company in order that it may arrive at the relative merits of each. The Baird transmissions will be analogous to silent films, as compared with the more recent sound films. In addition to the British transmission of television supplementary receptions will shortly be available from the Continent, for negotiations are taking place for transmissions by the Baird process from high-power stations in Brussels and Paris. The Post Office station in Dublin is also to establish a television service.

## Russian Orders for the Clyde.

As a result of the recent visit of the Soviet Trade Delegation to Glasgow, two important orders for machinery have been placed with Scottish firms. They include a contract for the supply of mining drillers, which has been placed with Andrew G. Kyle and Co., Ltd., of Galston, and a £100,000 order for coal-cutting and mining machinery, which has been placed with Mavor and Coulson, Ltd. Work on the new order is to be begun at once at the new East-Kilbride works of the firm, which have been specially laid out for the rapid and economical production of coal-cutting plant, and coal-handling appliances. It is understood that the Soviet officials are already in touch with Harland and Wolff, Ltd., with regard to the construction of ships for Russia at their Govan yard, while visits will also be paid to the principal shipbuilding and engineering establishments of the Clyde by the members of the delegation.

## The Assuan Dam.

THE Assuan Dam, when it was completed in 1902, was 120ft. in height. In 1907 work was begun on a scheme for increasing its height by 23ft. That work was completed in 1912. In February of last year, following the favourable report of an International Commission, the Egyptian Government decided to add yet another 23ft. to its height, the cost being estimated at £3,800,000. The contract for the work was placed with Sir John Norton Griffiths and Co. It is reported this week from Cairo that the contractors have notified the Egyptian Ministry of Public Works that the conditions of work imposed on them by the Egyptian resident engineering staff make it impossible for them to continue the heightening operations and that, as a consequence, they have stopped work. Charges of inexperience and technical incompetence have been advanced against the Egyptian engineering inspectors at the dam, and it is stated that they have for some time been obstructing the progress of operations. The Egyptian Government has issued a communiqué on the subject. While it admits that the contractors have intimated that they were not prepared to continue the work because of "certain matters concerning the work itself," the Government's announcement is principally concerned with the financial aspects of the question. It states that the heightening operations had not been proceeding at the proper rate and that efforts had been made by the Ministry of Public Works to secure expedition. The contractors, the communiqué proceeds, had called attention to the difficulties of the financial situation and had asked the Government for assistance. While the Government was considering this request, the intimation was received that the contractors were not prepared to continue the work. Sir John Norton Griffiths, discussing the Government's statement, has stated that whether the financial position had been satisfactory or not, the suspension would have been inevitable on technical grounds. By this time, he says, they should have been able to execute some £200,000 worth of work on the dam. Actually, they had only completed £40,000 to £50,000 worth. The difference of £150,000 made the position of the company difficult as regarded farther expenditure.

## The British Association.

AT its meeting in London under the presidency of General Smuts, from September 23rd to 30th next year, the British Association will celebrate the centenary of its foundation. The President, Treasurer and Secretaries of the Association have this week issued an appeal for subscriptions to a Centenary Fund of £40,000, which they are desirous of establishing. The object of the fund is in the first place to meet the expenses connected with the centenary celebrations, and in the second to enable the Association to continue and extend its activities in the holding of meetings and the promotion of scientific research. The subscription for the annual meeting remains to-day at the figure of £1 at which it was fixed in 1831. The sum derived from this source fluctuates, but averages about £2500 a year. The Association has an invested capital of £8000 and administers funds amounting to £50,000, with which it has been endowed by Sir Charles Parsons, Sir Alfred Yarrow, Mr. Buckston Browne, the late Sir James Caird, the late Lieut.-Col. Alan Cunningham, and others. Altogether the Association's income comes to about £5600 annually. Its expenditure on printing, salaries, office and other expenses amounts to £4150. The surplus of £1450 is all that is available for promoting research and for meeting other expenses to which the Association's work commits it. Its financial constitution has always compelled the Association to live, in a measure, from hand to mouth, and it is with the ultimate object of removing the stringency under which it has laboured that the appeal now launched has been promoted. Subscriptions to the fund, addressed to the General Treasurer at Burlington House, W. 1, may, if the donors so desire, be earmarked for research in any particular department of science or for any particular aspect of the Association's work.

## Replacing the Lost S.S. "Tahiti."

ON Saturday next, September 27th, the Australian liner "Monowai," of the Union Steamship Company of New Zealand, will make her first voyage, replacing the steamer "Tahiti," which was lost recently in the Pacific Ocean by the breaking of the tail shaft. The New Zealand Nautical Court of Enquiry found that the ship was staunch and well found, and that the loss occurred by the breaking of the tail shaft, probably by reason of a diagonal or scarf fracture, which resulted in the shaft over-riding itself and puncturing the hull, and the base of the water-tight bulkheads. The report referred to the resource shown and the cool and accurate judgment of the master of the ship and the courage and endurance shown by the engineering staff. Happily, there was no loss of life associated with the sinking of the ship. The new steamer above referred to has been purchased from the P. and O. Company and was formerly the "Razmak." She has a length of 519ft., a beam of 63ft., and a moulded depth of 38ft., with a gross tonnage of 11,000 and displacement of 18,000 tons. Her propelling machinery comprises two sets of quadruple-expansion engines with a designed output of about 12,000 I.H.P., working in conjunction with oil-fired Scotch boilers and giving a speed of 18 knots. The ship was built and engined by Harland and Wolff, Ltd.

## The Institute of Marine Engineers.

THERE was a good attendance at the first meeting of the new session of the Institute of Marine Engineers on Tuesday evening last, September 23rd, when the presidential address was delivered by the new President, Lieut.-Commander Sir August B. T. Cayzer, Bart., R.N. (Ret.). Sir August took as his theme the recent progress made in marine engineering, and briefly recounted the advances recently made. The exhaust turbine coupled to the reciprocating steam engine by the Bauer-Wach hydraulic clutch or similar arrangements had enabled 12½-knot, 9000 to 10,000-ton deadweight carrying capacity steamers to maintain 13¼ to 13½ knots, or, alternatively, to operate at their original speed with a saving in fuel consumption of 20 to 25 per cent. Progress had also been made with the turbo-electric drive, and good results obtained. Boiler pressures had been increased and the water-tube boiler was receiving careful attention. The next step would probably be influenced by the progress made in coal distillation and the production of coal oils and special fuels. The internal combustion engine had given excellent results in certain cases, but there was a necessity for British ships to use, if possible, British coal or oil produced therefrom. The recent progress made called for a more extensive knowledge on the part of marine engineers, and the education of the engineer must embrace a wider field. A wider and deeper knowledge of engineering problems was now demanded from superintendent engineers and technical experts. But so far as Sir August's knowledge went, he thought that they had proved themselves fully equal to the calls which had been made upon them.

## The New Cunarder.

VARIOUS rumours have recently been current with regard to problems alleged to have been met with in regard to the insuring of the new Cunard liner and the construction of her propelling machinery. In an official statement issued early in the week, the Cunard Steamship Company stated that it had no knowledge of any insurance difficulty having arisen, and that so far it had not begun to place insurances for the new ship. The statement continued to the effect that the terms of the building contract had still to be settled with John Brown and Co., Ltd., of Clydebank, while with regard to the dry-docking of the ship at Southampton, the arrangements were still under amicable discussion. It is generally understood that the owners are considering schemes for the dry-docking of this 1000ft. ship in a graving dock and, alternatively, by a large floating dry dock. A statement just issued by the Cunard Steamship Company to its shareholders is reprinted on page 351.

## The Humber Bridge Scheme Condemned.

IN a Journal note of September 5th we referred to the proposal to construct a bridge over the Humber estuary and the deputation which was to be appointed by the Hull Corporation and the other local authorities who are interested in the scheme to place before the Minister of Transport the present position of the scheme. We may recall the fact that the Government has promised the sum of £1,750,000 towards the scheme, which has been supported by the Hull and other local authorities, but has not been supported by the East Riding County Council. In a recent report to the Humber Conservancy Board, Captain Butterfield, the engineer to the Board, condemns the scheme on the grounds that in preparing the scheme the interests of navigation have not been fully taken into account. The site selected, says Captain Butterfield, is a point at which there is great tidal influence on the river, and he suggests that the construction of twenty-two piers would have an effect which would in all probability be felt acutely on both sides of the bridge. He is unwilling to accept the responsibility for the irreparable damage which might occur to the channels both above and below the site of the bridge, should it be built. The Conservancy Board has decided to forward a copy of its engineer's report to the Ministry of Transport, with a view to emphasising the grave issues involved in the proposed scheme, and it has also authorised the engagement of a consulting engineer who will advise the Board with regard to the bridge scheme.

## The Haifa-Baghdad Railway Survey.

AN official announcement is made that, on the recommendation of the Colonial Development Advisory Committee, the Government has now approved the grant of a sum of money from the Colonial Development Fund for the purpose of carrying out a detailed survey in connection with the project for the construction of a railway from Haifa to Baghdad. The survey, which is to be undertaken by Messrs. Rendel, Palmer and Tritton, of Westminster, is to be carried out forthwith. Various references have recently been made with regard to the proposed railway, which, if built, would replace the present motor transport service which is in operation across the desert from Damascus to Baghdad. It is suggested that the proposed railway line should run south of the Yarmuk Valley and the Jebel Druze, which would avoid crossing French mandated territory. The railway, if constructed, will do much to further the transport of goods and passengers from Palestine to Iraq.

## New British Destroyers.

ON Tuesday last, September 23rd, the new destroyer H.M.S. "Boadicea" was launched from the Hebburn-on-Tyne yard of Hawthorn, Leslie and Co., Ltd. She is due for completion early next year, and a sister ship, H.M.S. "Blanch," which was launched at the end of May last, is now approaching completion and is expected to be ready for service in January. The "Boadicea" has a displacement of 1330 tons and her overall length is 323ft. She has a long forecastle deck and the quarters for the crew are more spacious and comfortable than those provided in earlier destroyers. The armament includes four 4·7in. guns, seven smaller guns and eight torpedo tubes. The propelling machinery which has been manufactured by the builders consists of a twin-screw arrangement of single-reduction geared turbines designed for an output of 34,000 S.H.P., steam being raised in three water-tube boilers provided with superheaters and arranged for a working pressure of 300 lb. per square inch and 200 deg. superheat. The boilers are oil fired and the stokeholds are closed. The oil fuel bunker capacity is 380 tons.

# The Shishkoff Hydro-Thermal Tidal Power System.

No. I.

DURING a recent period of suitable tides we visited Avonmouth for the purpose of inspecting the construction, operation and testing of an experimental tidal power plant, which has been erected at the Old Lock, Avonmouth Docks. The system of working exemplified by the plant is that covered by the patents of Mr. Paul Shishkoff, formerly a subject of his Imperial Majesty the Emperor of Russia. Its development is in the hands of Hydro Thermal Power, Ltd., 3, Victoria-street, S.W. 1.* The tests which were in progress at the time of our visit, and to the results of which we make reference below, were being carried out by Messrs. Kincaid, Waller, Manville, and Dawson, consulting engineers, of Westminster. The plant is on a small scale, its designed continuous—twenty-four hour—load being only 16 kW, with a peak load of 32 kW. It has been erected to test the practical working of the system and to provide experimental data on which to found the design of large installations on the Shishkoff system. It has been erected at Avonmouth Docks with the consent and assistance of the Dock Authority—the Bristol Corporation—not because the system is in any way associated in its principle with the operations conducted at docks, but simply because a dock basin with its lock gates provides without expense a volume of impounded water, the head of which varies with the state of the tide in much the same manner as would the head of water in a specially constructed tidal reservoir. The system has important fields of application open to it other than the generation of power from the tides. Notably, it is applicable to any hydro-electric undertaking in connection with which it is not practicable to store water. In such a case the surplus power available during the between-peak periods, instead of being lost, would be stored as steam, which would be used in steam turbo-alternators to increase the peak output of the station. It is also applicable to a hydro-electric station working in conjunction with a manufacturing establishment—for example, a paper mill—which requires a supply not only of power, but of steam or hot water.

---

The general nature of the problem to be solved in devising any scheme for the generation of power from the tides is well understood. It was discussed very fully in our columns by Mr. Norman Davey in a series of articles "Studies in Tidal Power," which we published during December, 1920, and it has received attention from many other writers. The situation which presents itself is summarised in the diagram reproduced in Fig. 1. The full line curve represents

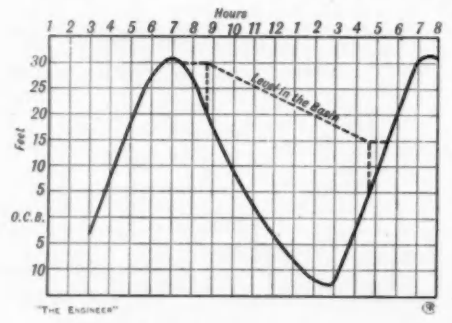



FIG. 1—TIDAL CURVE

the variation in the sea level during a period of seventeen hours at a particular situation where the tidal range is about 44ft. High water occurs at 7 a.m. and at 7.30 p.m. The incoming tide is admitted to the basin and at 7 a.m. it is full and is isolated from the sea. At 8.45 a.m. the tide has fallen to an extent giving 10ft. difference between the sea level and the level in the basin. This head is taken as the minimum at which it is practicable to operate the turbine for the generation of power. The falling tide is accompanied by a fall in the level in the basin consequent upon the efflux of water therefrom through the turbine. The two rates of fall do not, however, balance each other. The difference of level—that is, the head available for operating the turbine—increases steadily until some time before low tide. At or about 1.15 p.m. the head becomes substantially constant, at 32ft. approximately, and it retains that value until full low tide at 3 p.m. With the return of the tide, the difference of level between the sea and basin water rapidly decreases and at 4.45 p.m., the head having fallen to 10ft., the turbine has to be shut down. At 5.30 the tide having risen a further 10ft., a start can be made with refilling the basin. At or about 7.30 p.m. the basin will be full and at 9.15 p.m. the tide having fallen 10ft., the turbine can be restarted for a second run.

According to the curve, it will be seen that power can be generated for eight hours out of every 12½ hours. During the eight-hour period the head available increases from the original value to more than three times the original value in a space of 4½ hours, remains constant for 1¾ hours, and diminishes down to the original value in 1¾ hours. During the 4½-hour, period when power is not being generated, there is a stage lasting three-quarters of an hour in which the sea is rising 10ft. to the level in the basin at the end of the run, a stage of two hours in which the basin is filling, and a stage of 1¾ hours in which the tide is falling 10ft. below the basin level. The precise periods and heads available will depend upon the locality of the station, and at any one station will vary during each month. It is also to be noted that the exact hour at which the turbine can be started up will not remain constant from day to day, but will be approximately one hour later every twenty-four hours. It should further be observed that the size of the reservoir basin has a direct influence on the length of the period during which generation is possible. If, for example, the basin were so large that the water drawn from it for driving the turbine lowered its level by an insignificant amount, then the period of generation for the conditions represented in Fig. 1 might be extended beyond 4.45 p.m. almost to 6 p.m. At Avonmouth the dock basin is so large relatively to the amount of water passed through the turbine, that the level of water in the dock at the end of a generating period is only about 9in. lower than at the beginning.

From this summary of the general conditions it will be seen that the devising of a tidal power scheme presents two main problems. In the first place, in order to provide a continuously available power supply, some economic and efficient means must be arranged for storing surplus energy during the tidal generating period in order to meet the demand for power during the non-tidal period. Secondly, if the turbine is employed to supply power by means of an alternating-current generator, provision must be made for keeping the turbine speed constant while the head under which it is working varies over a range of 1 to 3 or more.

There have been proposals of many kinds for storing the surplus energy of the tidal generating period. Electrical storage batteries are inapplicable, on the score of expense, to a scheme of any magnitude. It has been proposed, in France, we believe, to use the surplus power for compressing air to be employed during the non-tidal generating period in compressed air motors. The official Severn barrage scheme, it is hardly necessary to remind our readers, contemplates the use of the surplus power for pumping water up into elevated reservoirs which would be drawn upon during the non-tidal period.

The Shishkoff system makes use of a thermal storage method in accordance with the plan indicated in Fig. 2, which shows the arrangement of the Avonmouth plant in diagram. The vertical shaft of the water turbine is coupled directly to a Heenan and Froudé brake and to a vertical alternator. The energy delivered by the water turbine is in part

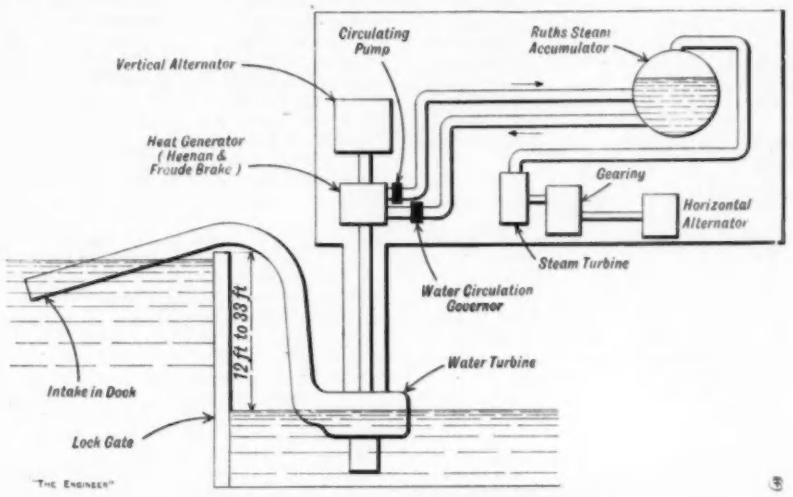
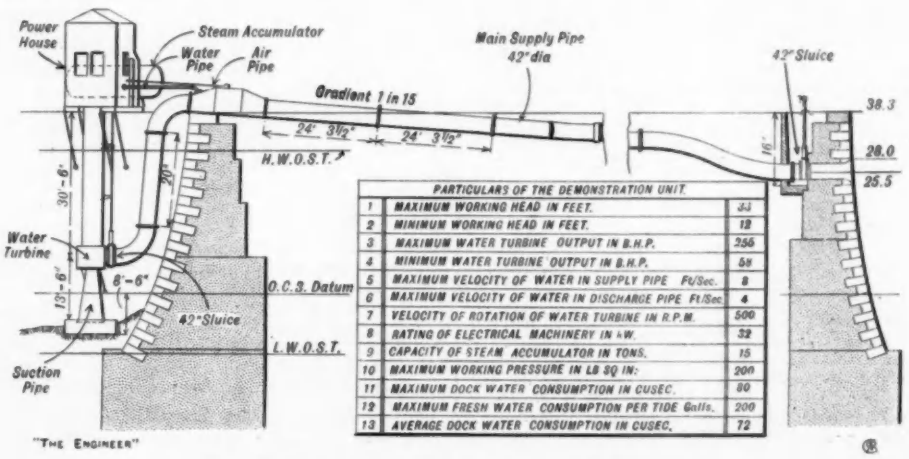



FIG. 2—DIAGRAM OF THE SHISHKOFF SYSTEM

directly converted into electricity by the vertical alternator for immediate consumption and in part is converted into heat by the brake. The water which receives the heat generated inside the brake is circulated by a pump in a closed circuit between the brake and a Ruths steam accumulator. As time passes the temperature of the water rises, steam is formed and the pressure inside the accumulator increases. At the end of the first period of tidal generation, if the water in the system was initially at atmospheric temperature and pressure, the pressure inside the accumulator may be about 50 lb. per square inch, the temperature being the corresponding steam table value, namely, about 298 deg. Fah. At the end of subsequent runs, however, the accumulator pressure may be 200 lb. and the temperature about 388 deg. Fah., for the accumulator, being well lagged, preserves




| PARTICULARS OF THE DEMONSTRATION UNIT. | | |
|---|---|---|
| 1 | MAXIMUM WORKING HEAD IN FEET. | 33 |
| 2 | MINIMUM WORKING HEAD IN FEET. | 12 |
| 3 | MAXIMUM WATER TURBINE OUTPUT IN B.H.P. | 255 |
| 4 | MINIMUM WATER TURBINE OUTPUT IN B.H.P. | 58 |
| 5 | MAXIMUM VELOCITY OF WATER IN SUPPLY PIPE Ft/Sec. | 8 |
| 6 | MAXIMUM VELOCITY OF WATER IN DISCHARGE PIPE Ft/Sec | 4 |
| 7 | VELOCITY OF ROTATION OF WATER TURBINE IN R.P.M. | 500 |
| 8 | RATING OF ELECTRICAL MACHINERY IN kW. | 32 |
| 9 | CAPACITY OF STEAM ACCUMULATOR IN TONS. | 15 |
| 10 | MAXIMUM WORKING PRESSURE IN LB SQ IN: | 200 |
| 11 | MAXIMUM DOCK WATER CONSUMPTION IN CUSEC. | 80 |
| 12 | MAXIMUM FRESH WATER CONSUMPTION PER TIDE Galls. | 200 |
| 13 | AVERAGE DOCK WATER CONSUMPTION IN CUSEC. | 72 |

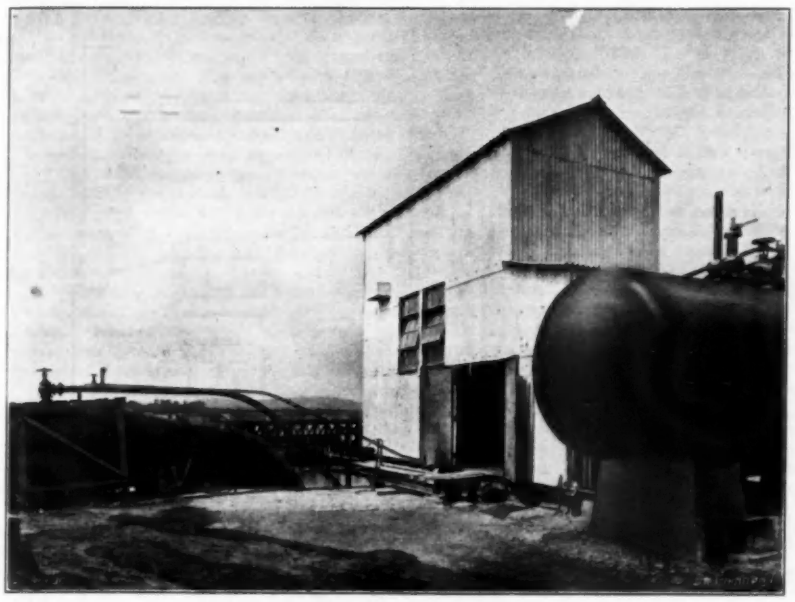
FIG. 3—EXPERIMENTAL PLANT AT AVONMOUTH DOCKS

with little loss the temperature of the water remaining from the immediately preceding cycle of operation.

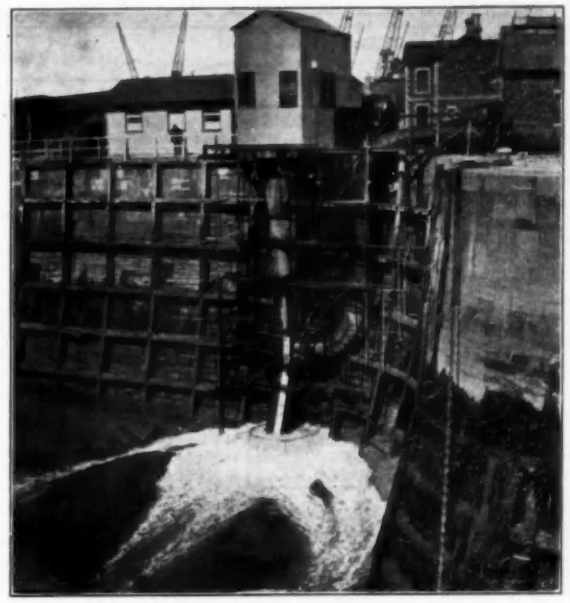
When, therefore, the working of the system has become established the energy delivered from the water turbine during the eight-hour tidal generation period is expended partly in supplying the immediate demand for electricity by way of the vertical alternator and partly in heating the water in the accumulator, brake and connecting pipes until its pressure is somewhere about 200 lb. At or just towards the close of the eight-hour tidal period steam is drawn from the accumulator and used to drive a de Laval steam turbine, which is coupled through the usual gearing to a horizontal alternator of the same size and possessing the same characteristics as the vertical alternator. With the shutting down of the water turbine and vertical alternator the horizontal alternator takes up the load on the station and carries it until the next tidal power period arrives. During this 4½-hour steam generation period the pressure

* The directors of this company are :—Sir George Buchanan, Mr. F. W. Hallewell, Sir Edward Manville, Brig.-Gen. E. L. Spears, Mr. H. Stokes Waite, Mr. R. H. Wheeler, and Commander V. V. Romanoff.

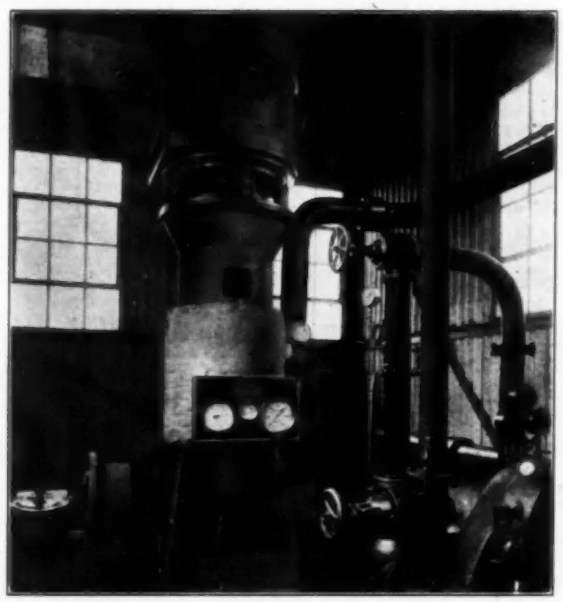
# SHISHKOFF TIDAL POWER PLANT AT AVONMOUTH



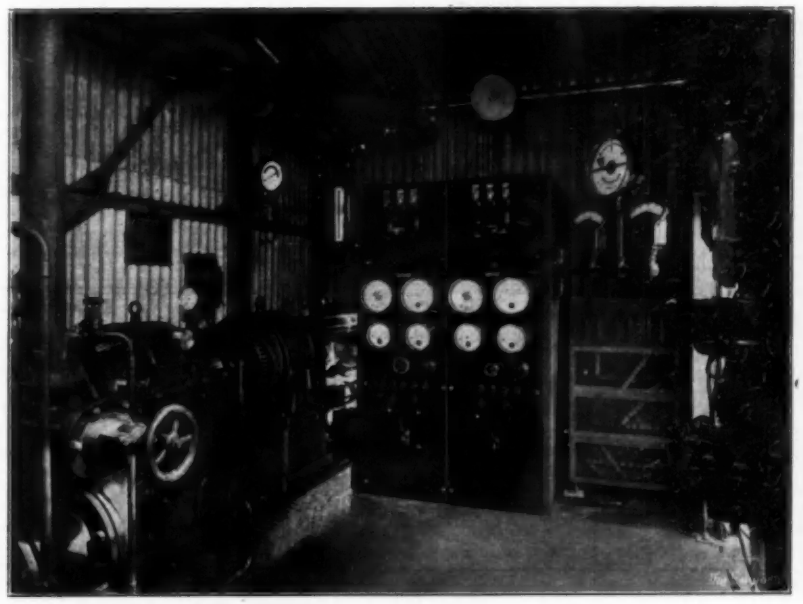
THE EXPERIMENTAL POWER-HOUSE



THE POWER-HOUSE AT LOW TIDE



HEAT GENERATOR AND VERTICAL ALTERNATOR

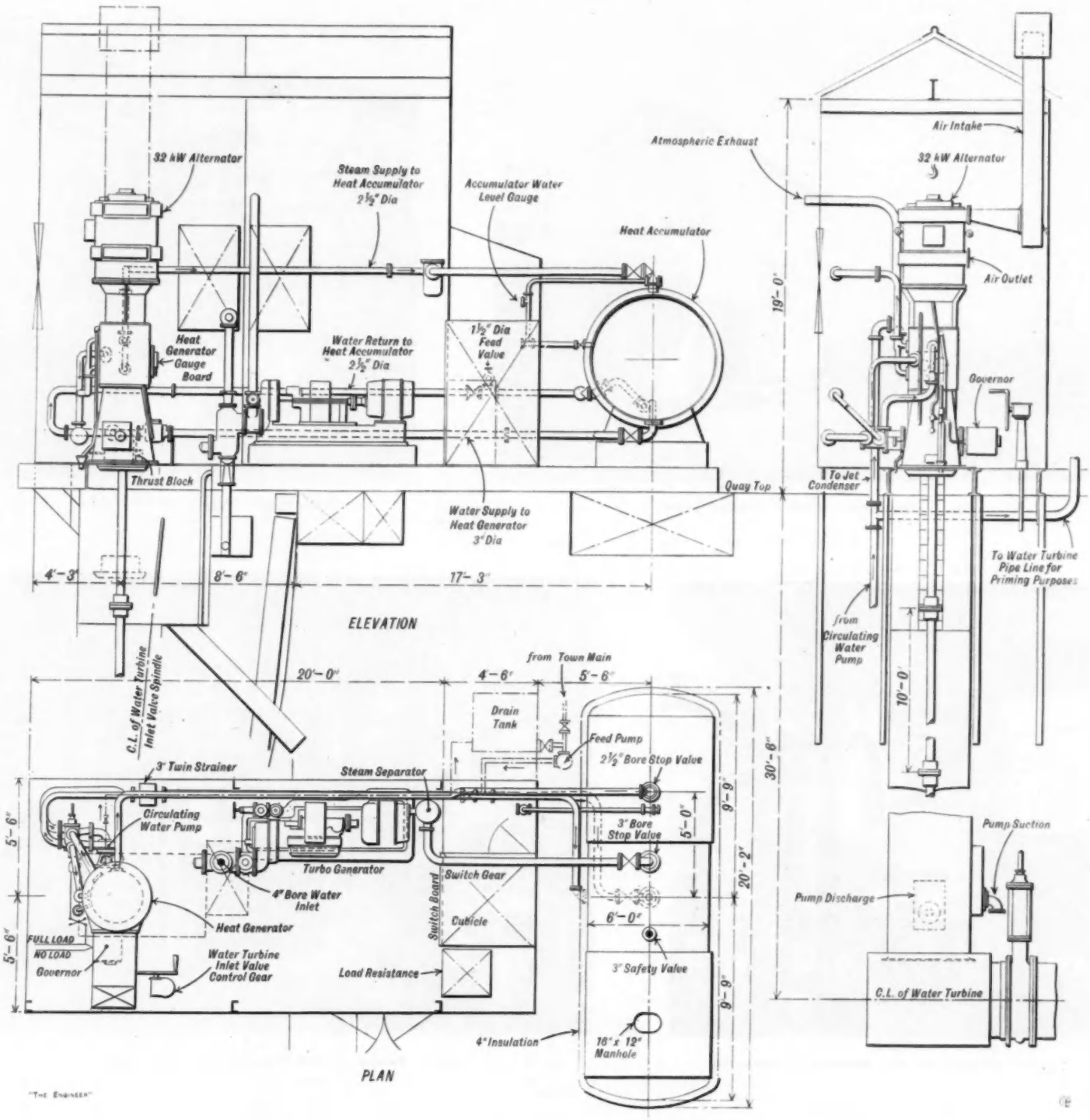


STEAM TURBO-ALTERNATOR AND SWITCHBOARD

SUPPLY PIPE, TURBINE CASING AND DRAUGHT PIPE

TURBINE CASING AND RUNNER

## EXPERIMENTAL TIDAL POWER PLANT AT AVONMOUTH DOCKS




inside the accumulator drops progressively, say, from 200 lb. at the outset to 50 lb. at the end. The steam turbine is designed to work with steam of varying pressure.

It will be seen, then, that in the Shishkoff system the surplus power available during the tidal period is converted mechanically into heat, which is stored for use in a heat engine during the non-tidal period. The second portion of the problem is to preserve the speed of the water turbine constant under the varying head derived from the tide in order that an alternating-current generator may be used as the source of the distributed current. This portion of the problem could readily be solved in a technically satisfactory manner by providing the water turbine with movable guide vanes operated in the familiar way through a governor and servo-motor. Such an arrangement would, however, be objectionable from the financial point of view. It must be remembered that the cost of generating a unit of electricity from the tides, or from a hydraulic fall generally, is very largely a question of interest and depreciation on the capital expenditure, and that excessive capital expenditure is the rock on which most tidal power schemes have in the past gone to pieces. The conditions demand the simplest possible form of water turbine, and in Mr. Shishkoff's view preclude the consideration of movable guide vanes and their accompaniments. In any event, the use of a hydraulic brake as a heat generator provides a simple alternative means of governing the speed of a water turbine, which need consist of nothing more than a runner working inside a casing with fixed guide vanes. This governing system consists of increasing or decreasing the amount of water passed through the heat generator or brake as the load on the electrical generator decreases or increases, or as the available tidal head rises or falls.

Before we pass on to describe the plant in detail and to record the results of the tests conducted on it, attention may be directed to the fact that none of the units composing it is of a special nature, the only item in the whole equipment which is not already in familiar use being the governor controlling the amount of water admitted to the brake. It ought perhaps to be added that the brake is of the Heenan and Froude standard type, except in so far as its use as a heat generator has rendered necessary one or two minor alterations designed to enable it to work with water which is both hot and under considerable pressure. At the time of our visit there was a serious leakage of hot water from the glands of the brake, but with a change in the nature of the packing and by otherwise improving the construction of the glands this loss has now, we understand, been reduced to a very small amount.

It may be argued, however, that while all the units of the plant are of a well-tried kind their number and variety constitute a feature of the system which is open to practical criticism. The list of the plant units is certainly a lengthy one. The main items are:—A water turbine, a hydraulic brake, an alternator, a circulating pump and a water governor for the brake, a steam accumulator, a steam turbine and condenser, another alternator and electrical switchgear, including synchronising equipment. In addition, we have to include the storage basin itself and the requisite filling and discharging piping and valves. It may, however, be noted that it is not impossible that in plants developed from the trial equipment the second alternator may be omitted, arrangements being made whereby the water turbine and the steam turbine may be coupled up to, or disconnected from a single alternator

We ought, too, to take into account not so much the number and variety of the units composing the plant as the capital distribution which they represent and the extent to which each pound of the capital expenditure is in profitable employment per twenty-five hours. The water turbine in the Shishkoff system is not a heavy item of expenditure. With the elimination of movable guide vanes it is reduced to a simple runner inside a casing, which in a large-size plant might be made of concrete throughout. The water turbine and the brake are the only items of the plant which have to be made of much larger capacity than the designed load on the station. For example, the 16–32-kW plant at Avonmouth is provided with a water turbine capable of giving up to 280 H.P. It is particularly to be noted that the electrical generator driven by the water turbine has a capacity which is not greater than the peak load on the station. In the alternative method of storing the surplus tidal power electrically there would have to be provided not only

the requisite number of storage batteries, but an electrical generator with a capacity equal to the maximum output of the water turbine.

With a cheap turbine and a small electrical generator the Shishkoff system seems to provide a favourable solution to the problem from the point of view of capital expenditure so far as the tidal generation portion of the plant is concerned. As regards the non-tidal generation portion, the verdict may be thought to be less favourable. The brake, as we have said, has to be capable of dealing with much more power than the designed load on the station. At Avonmouth the brake provided is designed to absorb at least 300 H.P. It is not, however, a very expensive item. It costs about the same as the water turbine. A feature of interest in this connection is that the capacity of the brake increases proportionately to the fifth power of its diameter. The relative cost of the brake should therefore fall off rapidly with increase in the size of the plant.

The generator driven by the steam turbine is of the same capacity as the generator driven by the water turbine. Setting the costs of the two generators against one another and the cost of the brake against the cost of the water turbine, we are left with the cost of the steam turbine and the steam accumulator as the additional capital expenditure incurred in connection with the non-tidal generation portion of the plant. Of this additional expenditure that involved in providing the steam accumulator is the heavier item. It may be taken as representing about 25 per cent. of the cost of the whole plant, excluding the basin and storage equipment. It is undoubtedly to be regretted that the heaviest portion of the capital expenditure is incurred in connection with that portion of the plant which is in useful service for the shorter period.

In Fig. 3 we illustrate the situation of the Shishkoff experimental plant relatively to the lock at Avonmouth Docks. On page 332 details are given of the power-house and its adjuncts, and on page 331 some interior and exterior views are reproduced.

The water turbine—see Fig. 4—was supplied by

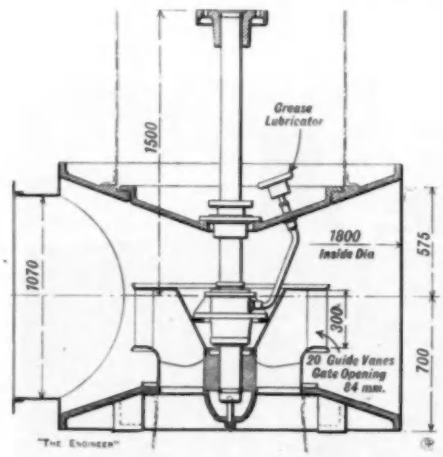



FIG. 4—SECTION OF WATER TURBINE

Boving, Ltd., and is designed to work with a head varying from 12ft. to 36ft. and to develop 58 to 280 H.P., according to the head, when running at a constant speed of 500 r.p.m. Over a tidal period the turbine has a mean efficiency of 84 per cent., the maximum efficiency being 86 per cent. and being given at a head of 25ft. The heat generator manufactured by Heenan and Froude, Ltd., is a modified standard hydraulic brake designed to absorb 300 H.P., but capable of absorbing 400 H.P. at 500 r.p.m. The vertical alternator was made by the English Electric Company, Ltd. It is directly coupled to the water turbine and heat generator shaft and has a rating of 32 kW at unity power factor. It generates three-phase current at 400 volts and a periodicity of 50. The steam turbo-alternator manufactured by the Swedish de Laval Company and the Swedish General Electric Company has a speed of 1500 to 15,000 r.p.m. and is rated at 32 kW at 0·8 power factor. The periodicity and voltage are the same as those for the vertical alternator. The synchronising gear and switchboard were supplied by the English Electric Company. The Ruths steam accumulator is 19ft. 6in. in length by 6ft. in diameter and has a volume of 510 cubic feet. It is operated with about three-quarters of its volume occupied by water. The brake and circulating pipes contain a further 300 lb. of water and the water equivalent of the metal in the accumulator, brake and circulating pipes is 3170 lb.

*(To be continued.)*

---

WITH the object of encouraging inventive talent amongst those whose circumstances do not permit them to take the ordinary course of technical training, the Institute of Patentees (Incorporated) in co-operation with the Association of Principals of Technical Institutions, has initiated a scheme of granting scholarships to polytechnics and local technical colleges.

## The British Association.

No. III.*

HIGH STEAM PRESSURES AND TEMPERATURE.

Section G (Engineering) on Tuesday, September 9th, discussed three papers, the first being by Mr. G. A. Orrock on "The Use of High Steam Pressures and Temperature in the Generation of Power," which is reprinted on page 339 of this issue.

In the absence of the author, the paper was presented by Mr. W. M. Selvey, who pointed out that Mr. Orrock was one of the pioneers in electric power. For many years he worked with the New York Edison Company and became its consulting engineer; finally going into business on his own account. He had taken an extremely great interest in the economical production of power.

The President, after thanking Mr. Selvey for having presented the paper, said that the economy of electricity supply financially was a matter of very great importance. We got along after the Napoleonic wars by an increase in our coal exports, but now we must turn our very cheap coal into electrical energy at a reasonable rate, and higher steam pressure was a step in that direction. As regarded the use of high pressures, he recalled that a ship called the "Prepontis" was run at 150 lb. per square inch in 1864. It had the first water-tube boiler anything approaching the marine type, and the pressure was an enormous one at the time. The boiler was something like the marine water-tube boiler of to-day, but the complications in the tubes made it difficult to get the best out of the boiler, and in 1876 it was abandoned owing to a serious burst. When he was an apprentice in Glasgow, the "Propontis" was always held up as a great advance in boiler working. He had taken the opportunity to write to Mr. Yarrow asking what his firm was doing in the matter of high pressures. A boiler was being supplied to Japan to go up to 1000 lb. and 800 deg. Fah., but he gathered that there was a little anxiety about the material for the tubes, because above 800 deg. Fah. the tensile strength of mild steel fell off enormously, although 34 to 36 ton steel was quite safe up to 750 deg. Fah. It was hoped, however, to obtain a higher tensile steel for the purpose. Mr. Yarrow had also stated that in the new Cunarder now being laid down by Brown's they were not going higher than 400 deg., which was well within what seemed to be the breakdown limit of the steel of which the larger vessels of the water-tube boiler were to be composed.

Dr. G. G. Stoney, F.R.S., said that the author had shown in his paper that doubling the pressure gave a saving of about 1000 B.Th.U. per kW hour. Therefore, a 15 per cent. rise of pressure would save 200 B.Th.U. per kW hour. That was the same gain as would be given with 100 deg. Fah. rise of temperature. A 15 per cent. rise of pressure was from 500 lb. to 575 lb., or from 650 lb. to 750 lb., and 100 deg. rise of temperature was from 750 deg. to 850 deg. Fah.; 750 deg. Fah. was about the limit of what mild steel superheater tubes would stand, and above that, troubles from creep and corrosion, &c., were met. It was very easy to see whether it was preferable to increase the temperature or the pressure from an engineering point of view. There was no difficulty in increasing the pressure if we were dealing with mechanical stresses only, but with high temperature there were troubles from corrosion, creep, expansion, and consequent distortion. Again, with very high temperatures there were distortions in the turbine, and the clearances had to be increased to enable the blades to run safely. Thus the advantages due to high temperature were to a certain extent discounted. His own experience had been that most of the troubles in turbines were due to temperature. Such pressures as were being dealt with in steam were quite low in hydraulic work, and yet there were practically no troubles there. If the temperature of steam were reduced, the wetness in the exhaust was increased, with consequent erosion on the low-pressure blades, but he was convinced that that could be dealt with effectually by draining the turbine and having suitable materials and design in the last rows of blading. In marine work the blades could be kept down to a speed at which erosion did not occur. Roughly speaking, there was very little erosion at 800ft. per second, but there was a great deal at 1000ft. per second, but keeping the speed down was not possible in land work, in which we were tied to 1500 or 3000 r.p.m on account of the periodicity of the alternator. At the same time, erosion was being overcome by suitable material and design of the low-pressure blades, and also by the draining of the turbine.

Professor F. C. Lea said that those who had visited the United States greatly appreciated the abundant kindness of American engineers in showing everything they were doing in the matter of higher steam pressures and temperatures. At the present time we were attempting to get as near the Carnot cycle as possible in turbines by bleeding, although, at one time, some engineers regarded the Carnot cycle as a figment of mathematicians. As regarded temperature, there was a danger in increasing it too rapidly, and that was indicated in the difference between testing steel slowly and rapidly, and it was important when using material continuously under pressure. If steel were tested slowly up to, say, 500 deg. Cent., the real stress, taking the time function into account, was only a very small fraction—say, one-third or one-fifth—of the apparent strength. It was, therefore, important to recognise that the rate of change beyond temperatures of 350 deg. Cent. of what he had called the limiting creep stress, was very rapid, and a region was reached where the limiting creep stress was small and there was danger in the case of superheat of continuous creep going on with risk of blisters forming in a few hours and the failure of the superheater tubes. Mild steel at 800 deg. Fah. would be safe, but it was important in the case of superheaters to keep the temperature so that there was no local heating, and the temperature must not be allowed to get beyond 900 deg. Fah. locally, or there would be great danger of failure. The problem with new steels was the technique of working them. In the case of superheaters, it was easy to weld the material, but in the case of some of the steels, which would stand higher temperatures, there were considerable technical difficulties in the manufacture of the superheater elements that had not yet been entirely overcome. The expansion of the ends was another important point. Progress, therefore, would only be made as the technique improved, and made it possible to use the new steels. For that reason, we should not push temperatures too high until we had obtained materials which had a limiting creep stress much higher than that of mild steel. The difficulties of erosion could be got over by using some of the alloy steels, already available, in the low-pressure end of the turbine—for instance, the high-nickel and chromium steels—because there was not the same difficulty in making turbine blades of those materials that there was in making superheater elements.

Dr. John Morrow thought that the trend of the discussion was in favour of increasing pressures rather than temperatures, and from the purely thermodynamic aspect it appeared that an increase of pressure was the more advantageous.

Mr. W. M. Selvey said that whilst, as the President had mentioned, we did not propose to go beyond 400 deg. temperature in the case of the new Cunarder, our Hamburg-Amerika friends, in a new ship being built, proposed to limit the pressure. The engineers' point of view on the question of temperature and pressure was not what was the value of them, *per se*. The engineer wanted to get on and wished to know what was holding him back. If pressure was a good thing, could he have too much of it? If he could, where was the limit at which he should stop? The same applied to temperature. In taking that viewpoint, the engineer had forced his colleagues concerned with the production of materials to make progress which otherwise might not have been made. New materials were undoubtedly wanted. It might be known to a good many that Professor Herzfeld, under the guidance of Mr. Dow, had put into the American station at Gilray an experimental superheater at 1000 deg. Fah. Experiments had been carried out on it for over a year, and as a result of that and other work we knew perfectly well the kind of material which had a yield point or creep stress well within the requirements. As Professor Lea had mentioned, however, that material was very difficult to draw into tubes and, further, it was necessary to use tubes longer than could be drawn. That necessitated jointing lengths together and welding difficulties arose there. At the same time it had been stated that such material could be welded. The question of erosion was solving itself on account of size. Erosion was serious in the case of small blades, but with blades 2ft. or 3ft. long, 3in. or 4in. across and ½in. thick, the surface erosion was very much less. Moreover, the increasing purity of water was also playing a part in reducing erosion.

The second paper on the 9th was "The Question of Fuel Consumption in Locomotive Boilers," which, in the absence of the author, Sir Henry Fowler, K.B.E., was read by Dr. S. J. Davies, Secretary of Section G. This paper was reprinted on page 277 of our issue of September 12th.

The President remarked that on the Buenos Ayres and Southern Railway, Diesel engines driving generators were being employed, the final drive being through electric motors. It was fairly notorious that the coal consumption on locomotives was exceedingly inefficient under the ordinary conditions of running owing to the very low load factor at which the engines ran, but with the use of Diesel-electric or turbo-electric propulsion it seemed that the load factor could be improved and the economy of operation greatly increased. As far back as twenty-five years ago, in a discussion on a paper by Mordey and Jenkin on one of the tube railways in London, he himself had had the temerity to suggest that if a steam turbine running a generator, with electric motors, could be employed for driving trains, it would be possible to reduce the weight on any pair of axles considerably and so save our over-stressed bridge floors and, incidentally, get a better fuel consumption per horse-power. The Diesel-electric system was now being introduced, and he felt there were great hopes for it, especially if regeneration was also adopted.

OBSCURED FUNDAMENTALS IN ELECTRICITY SUPPLY.

The final paper taken on September 9th was entitled "Obscured Fundamentals in the Develop-

* No. II. appeared September 19th.

ment of Integrated Electricity Supply," by A. L. Stanton and Theodore Stevens.

This paper was a detailed study of certain aspects of the economics of electricity supply, and intimated that "integrated electricity supply" meant "an inclusion of everything that serves to make an electrical utility complete throughout all the links which lie between its primary source and any point of applied function, no matter where located, how served, or how utilised." The authors consider that, in the coming electrical age, the most important body of consumers in all areas of dense population would, undoubtedly, be the, at present, much neglected domestic section. The present position of electricity supply in this country was described as representing a stage only in the establishment of what was desired to convey by the use of the word "integrated." Calling attention to directions in which progressive effort is necessary at once, the authors remarked that little or no evidence was available that the problem of extending networks commensurate with the possible demand for domestic heating and cooking was receiving practical attention. Would not, they asked, a settlement of these problems prove an important factor in the ultimate success of the national scheme? Again, it was regarded as necessary that distribution undertakers should pool their experience and purchasing facilities, to the common advancement of load building. Overhead line work was mentioned as another section of development around which many anomalies existed. Disliked by many distribution authorities, having predominant underground interests, the place and function of overhead lines in the economic scheme of load building had never been properly investigated and therefore regulations of a restrictive order were never challenged. Generally accepted standards of economic construction were not in evidence, and the cheapest and best methods for supplying demands in rural areas in particular were not available.

Turning again to the domestic consumer, it was pointed out that no compulsory wiring standards were in evidence, and that the conditions under which a great deal of work was carried out were not conducive to the best work, nor always the cheapest consistent with a satisfactory standard of quality. The position, too, as regarded tariffs was referred to as manifesting a lack of ability to evolve a system that would prove both clear and simple to the average man and woman, as well as satisfactorily comprehensive from the suppliers' point of view. Until the absence of an acceptable system was remedied, a complete integrated supply would remain remote. The consummation of the improvements indicated, the authors claimed, would inevitably create vastly better administration, control and direction, whilst specialisation would play a greater part than it did at present.

The paper contained a large number of curves based on the Electricity Commissioners' returns indicating the principal features of electricity supply in this country and also, incidentally, a strong condemnation of the proposed Severn water power scheme upon the decision not to proceed with which the nation was congratulated by the authors.

The President said that the authors' criticism of the proposed Severn scheme was perfectly true and quite obvious. The Severn was a tidal river, which had no continuity except that pumps were suggested for pumping water into a lake that did not exist. He regarded the scheme as farcical. As concerned the general development of electricity, there was the Electrical Association for Women, which had 900 members in London and 5000 members outside London. Those women were exceedingly enthusiastic and were pushing the domestic use of electricity very rapidly. Unfortunately, they were faced with high costs, as pointed out in the paper; but, no doubt, with their natural persistence, the women would succeed in getting these costs reduced. Speaking of the "Grid" scheme, the President said that he had been informed that to tap off the 132,000-volt transmission lines was only possible at great expense and would only be done for a very large demand. He did not know whether that was right or not.

Professor E. W. Marchant said that he had been a little puzzled as to what the "obscured fundamentals" were. The "grid" scheme mentioned by the President, was very largely a political matter as well as an engineering one. In the case of large industrial towns, the "Grid" scheme would not assist in reducing the cost of electricity because central stations in those areas could produce electricity more cheaply than the price they had to pay for the "Grid" supply, and they also had to pay a certain amount towards the maintenance of the "Grid." On the other hand, in the case of districts far removed from the industrial centres, the chance of getting an economical electricity supply without the "Grid" was nil. In reply to the President's remark concerning the cost of tapping from the 132,000-volt lines, Professor Marchant said that it had been stated to be £50,000, and unless there was a large demand in a district it would not pay to tap from the main transmission lines. As to the development of domestic electricity supply, more was to be gained by a suitable tariff than in any other direction, whilst supply engineers should also take up the question of maintenance of domestic electrical apparatus, so that a consumer could at once have a defect remedied promptly. All supply authorities should have their maintenance staffs. It was done in Liverpool and he hoped it would be done elsewhere.

Professor F. C. Lea said that in the case of anything going wrong with the water supply, he could always send to the water department and get the trouble put right at once, but if anything went wrong with his electrical apparatus he had to do it himself.

Professor F. G. Baily (Edinburgh) endorsed what had been said with regard to the Severn water power scheme. It was even a little more far fetched than some of the Scottish schemes, a careful analysis of which showed that better results would be obtained with coal. The definite limitations to our water power were well known, but we did not know yet what improvements were likely to be made in the use of coal.

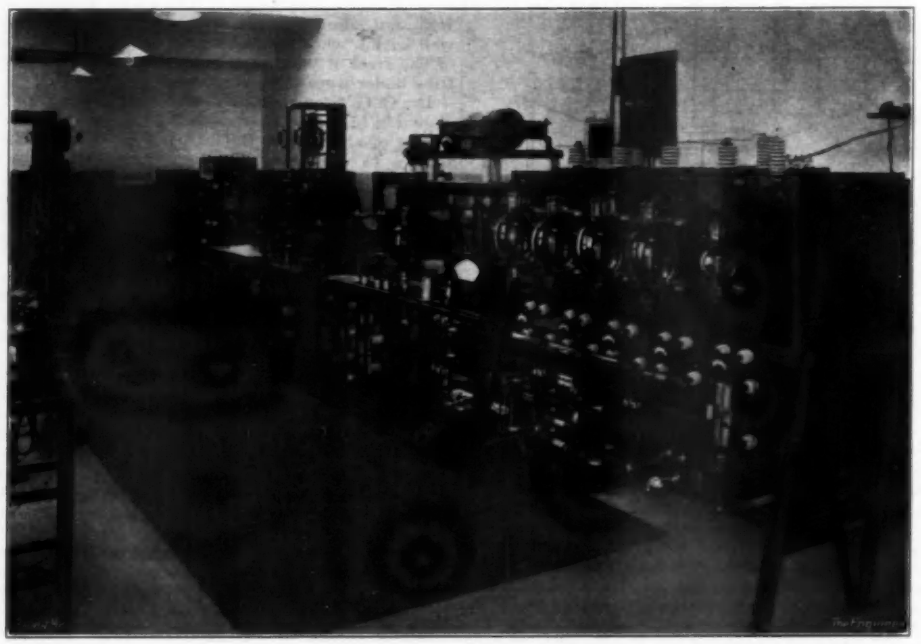
Mr. J. S. Wilson (Recorder, Section G) said that although small water power schemes had been disparaged, consideration should be given to all the facts. For instance, when the Chester scheme was first proposed, it appeared quite hopeless. The head of water was varying all the time, but it was decided to try it. As a matter of fact, the scheme was a phenomenal success, and during the war it proved a perfect God-send, because of the difficulty of getting coal. All the tramways and the city lighting were maintained for a considerable period with this small water power plant on the Dee.

The President said that he quite agreed that small water power schemes should not be despised because they were small.

*(To be continued.)*

## The Wireless Exhibition.

ON Thursday evening, September 18th, the Right Hon. J. H. Thomas opened the Wireless Exhibition at Olympia by broadcasting a speech from London, and at 11 a.m. on the following morning the doors of the Exhibition were thrown open to the public. Although the show has little connection with engineering in the true sense of the word, it represents an important industry which has made remarkably rapid strides within the past few years. Directly and indirectly the wireless industry gives employment to nearly a million people, and so far as skilled labour is concerned the industry is one of the few that has a clear unemployment register.



THE ORIGINAL B.B.C. MARCONI TRANSMITTER

For the most part the show consists of well-finished portable and other receiving sets, components, valves and batteries, but the B.B.C. has introduced a feature which should appeal to visitors who are not merely interested in home receiving sets. The apparatus used to supply music and speech to all the main loud speakers operating in the Exhibition is on view, the programmes distributed being obtained either from the B.B.C. headquarters at Savoy-hill or from a small studio on the stand. The programmes originating from Savoy-hill are the same as those radiated either by the London Regional or the National transmitter at Brookman's Park, the apparatus on the stand being connected directly to the amplifier at Savoy-hill through the medium of the G.P.O. telephone lines; whilst, when the broadcast transmissions are not available, a microphone and gramophone in the small studio on the stand are brought into operation. On one side of the main amplifier there is the input equipment, comprising five stages of resistance capacity coupled low-frequency amplification and the output from this equipment is fed to the main power amplifier which consists of two stages of push pull resistance capacity coupled amplification. High and low-tension supplies for the latter are derived from a motor generator set which delivers about 40 ampères at 17 volts to the filaments of the four large valves employed in the output stage, whilst approximately 1½ kW at 3000 volts are dissipated in the anodes. The loud speakers are fed in parallel through a number of separate circuits which supply various parts of the Exhibition.

The original Marconi transmitter at the London station shown in the accompanying illustration is also on view. It was the first broadcast transmitter of the British Broadcasting Company and was installed at Marconi House, Strand, the original "2 LO." When compared with the modern high-power transmitters at Brookman's Park, the progress made in transmitter design during the last few years at once becomes evident. The transmitter shown was erected in an experimental form in the early part of 1922 and was used for occasional broadcasts until the advent of regular broadcasting from London on November 14th, 1922. Under the control of the B.B.C. it remained in operation until it was replaced by the new transmitter in Oxford-street, which has now been replaced by the London Regional transmitter at Brookman's Park.

The first panel on the left is a rectifying panel for rectifying both halves of the 500-cycle alternating-current supplied by a 6-kW alternator through a step-up transformer with a ratio of 500/11,000 volts. The next panel contains the smoothing system, consisting of chokes and various condensers and forms the supply for the operation of the transmitter. The third panel is the drive or master oscillator and maintains constant frequency of the main oscillator which is accommodated on the next two panels, the first of which carries the tuning circuits, whilst the oscillator with its various coupling and blocking condensers is on the right. The last panel carries the modulating valves. The speech input to these valves was taken from a telephone line connecting with the studios in Savoy-hill.

Besides this original transmitter the B.B.C. is showing apparatus employed for various purposes, including a main closed circuit coil, a variable oil-dielectric condenser, a water cooled valve jacket, and an insulating hose former. Another section of the stand is devoted to a display of portable apparatus used for line testing. A "tone source" supplies alternating current at any frequency up to 10,000 cycles per second and is used for testing lines that are to be used for carrying broadcast programmes. The apparatus is in two boxes, one of which contains the oscillating valves which generate the testing current, whilst the other contains an amplifier for use in conjunction with the generator. Another piece of apparatus is a volume indicator used for measuring the strength of a programme being transmitted over a line. A portable repeater on view consists of a special amplifier for use on outside broadcast lines and includes a device for eliminating tone distortion due to the lines. There is also an amplifier detector—a very sensitive instrument—for detecting and measuring voltages received at the end of a line and is used in conjunction with a tone source. A portable attenuator shown is used for introducing an artificial loss in signal strength of known amount for the purpose of comparison. Five different types of microphones are on view: the solid back, the round experimental, the Western Electric, the Magnetophone, and the

Reisz. Other B.B.C. exhibits consist of a portable amplifier used for the first nightingale broadcasts and transmitting valves of the ordinary and water-cooled types.

Portable receiving sets are more numerous than ever, and some of them are arranged for working from the mains. The all-mains type of receiver is a very prominent feature of the show, but battery sets are still the most numerous, and many makes of high and low-tension batteries are in evidence. Mains units are also very prevalent. Amateurs who desire to convert their existing sets into all-mains receivers are well catered for. A very instructive little book on how to build high-tension and low-tension battery eliminators and chargers with metal rectifiers is being given away at the Exhibition by the Westinghouse Brake and Saxby Signal Company.

A noticeable feature in set design is the tendency to increase the number of valves, instead of endeavouring to decrease the number as in the past, a tendency that is no doubt attributable to a large extent to the reduction in the royalty per stage. Except in the case of sets that have been designed only for local reception, the old practice of cutting down the number of valves to a minimum has been abolished. On this occasion sets with two tuned stages of high-frequency amplification are well to the fore, and listeners who are mainly interested in sets that will bring in many stations will find plenty of exhibits that will appeal to them.

Of the new "kits" for home assembly one of the most interesting is that shown by the General Electric Company. The receiver has two stages of screen grid valves and a single tuning control. By the operation of a switch the set covers both medium and long broadcast bands. Adequate shielding ensures stability and ease in tuning in distant stations. The kit has been specially designed to ensure maximum selectivity under the new B.B.C. regional scheme; it is said to be exceptionally simple to assemble and is supplied complete with a polished oak cabinet.

Ferranti Ltd. are showing the whole range of their wireless products, including two and three-valve all-mains receivers, audio frequency transformers, push pull transformers, output transformers, mains transformers, chokes, condensers, battery chargers, and so forth. In one of the demonstration rooms the firm is also giving continuous demonstrations of all types of loud speakers of which the Ferranti Magnodynamic permanent magnet speaker is perhaps the best example.

These demonstration rooms form a very attractive feature of the Exhibition and are well patronised by the visitors, so much so, in fact, that it is often impossible to gain access to them. In these rooms all forms of loud speakers are to be found. The permanent magnet moving coil type of loud speaker seems to be very popular, but moving coil loud speakers with an electro-magnetic field are also shown by a fair number of firms. McMichael and Co., Ltd., are showing a permanent magnet model of new design with adjustable tappings for matching the speaker impedance to a wide range of output valves. Marconiphone moving coil loud speakers are exhibited in cabinet and chassis form for alternating-current and direct-current mains and for use with a 6-volt accumulator and incorporate a semi-flexible diaphragm which is claimed to ensure a perfect balance of tone free from all resonance. In view of the increase in the use of permanent magnet moving coil loud speakers, the exhibits of the firms of Darwins, Ltd., and Swift, Levick and Sons, Ltd., which are showing magnet steels, should prove of considerable interest to manufacturers of loud speakers.

Pick-ups for the reproduction of gramophone records on receiving sets are again still very much to the fore and many of them are said to have been considerably improved since the last Wireless Exhibition. The valve manufacturers are, of course, well represented, but it cannot be said that any of their exhibits represent a radical change in well-established principles. The screen grid valve, the Pentode and valves with indirectly heated filaments were all exhibited last year. Many of the valves shown are, however, said to have undergone improvement during the past year. New types of indirectly heated alternating-current mains valves, screen grid valves and pentodes are exhibited, for instance, by the General Electric Company, which is also showing super-power valves and rectifier valves for alternating-current mains sets and eliminators. There are, of course, many components, such as audio frequency transformers, condensers, tuners, and so forth, all of which show considerable improvements in design since the early days of broadcasting. The whole Exhibition, in fact, serves to indicate that within the course of a few years remarkable ingenuity has been brought to bear on the design and construction of wireless receiving apparatus, and that every conceivable requirement of the listener and experimenter has been met.

Although television does not constitute a feature of the exhibition, demonstrations are being given by the Baird Company in a building nearby.

---

A MILL capable of producing steel strip at the rate of 25,000 tons a month, and up to 26in. wide, has been started by the Illinois Steel Company at Gary, Ind.

## Institute of Metals.

No. III.*

THE meeting on Thursday, September 11th, began at 9 a.m., although for an hour or so the attendance was not very large. The first paper taken was "The Effects of Two Years' Atmospheric Exposure on Breaking Load of Hard-drawn Non-ferrous Wires," by Dr. J. C. Hudson.

### ATMOSPHERIC EXPOSURE AND THE BREAKING LOAD OF NON-FERROUS WIRES.

The author gives details of tests on a number of hard-drawn non-ferrous wires, in which determinations of the breaking load were made before and after exposure to the South Kensington atmosphere for two years. Owing to the fact that appreciable changes took place in the strength of the unexposed wires, it is not possible to arrange the materials in a definite order of merit as regards resistance to atmospheric corrosion. The losses in strength after two years' exposure were, however, very small, and the observations confirm the results of earlier work in showing that under straightforward conditions the majority of non-ferrous materials are very resistant to atmospheric corrosion. Brass is an exception, as its strength is adversely affected by the copper re-deposition that accompanies atmospheric corrosion. A few remarks are made on the atmospheric corrosion of copper-nickel alloys.

Dr. W. H. J. Vernon said that when the corrosion was confined, or practically confined, to the surface of the specimen, the tensile test method of measuring corrosion was insufficiently sensitive. That was borne out by the results in the paper. A much greater sensitivity could be obtained from the ordinary loss in weight method. Where, however, the corrosion penetrated into the body of the material—i.e., where there was any appreciable metasomatic change—then the tensile test method responded completely and afforded a satisfactory index of the total corrosion. It was in those circumstances that the loss in weight method broke down and became entirely useless as a measure of corrosion. The electrical resistance method, so successfully developed by the author, did not seem to respond quite so well where the dezincification of brass was concerned, owing, presumably, to the conductivity of the redeposited copper. In such cases, the tensile test method was by far the best. It was necessary to guard against the impression likely to be given by the paper that the materials tested, other than 70/30 brass, would necessarily be incorrodible under all conditions of atmospheric exposure. The author's tests were under what might be called straightforward conditions which were favourable to longevity, but even in the case of copper, which was probably the most resistant of all the other materials mentioned in the paper, there were circumstances in which corrosion might be quite a serious problem. For example, within recent years the Post Office engineers had found it necessary to study the corrosion of copper conductor wires not over the length of the wires, but in the neighbourhood of joints. It had been thought that in a twisted sleeve joint, where there was no question of contact with dissimilar metals, no protection against corrosion would be necessary. Tensile test methods, however, showed a marked loss of strength at the joints during service. That was attributed to corrosion, and the trouble was stopped by the use of a protective varnish. The statement made in the paper that the corrosion of thin wires was much greater than that of strips of the same metal, confirmed recent work by Luce, who had shown that the curvature of a given solid had a very marked influence in accelerating chemical or electro-chemical action upon that solid. Dr. Hudson's work indicated some striking results in that connection and particularly that it accelerated the dezincification of brass and that it nullified the protective influence of arsenic. The apparent discrepancy between the author's results with regard to the influence of brass, and those reported by Friend was, he believed, explained by the fact that Friend used circular bars, whilst Dr. Hudson and himself had used flat plates, and hence a much greater protective influence was observed. The fact, too, that arsenical copper showed to much greater advantage in his own tests as compared with the author's was probably explained in two ways: first, by the longer duration of the tests in his case, which extended over four years, and second, by the much greater area of the test plates. Nevertheless, there was little doubt that arsenic did exert a very pronounced restraining influence on the atmospheric corrosion of copper when that metal was used in the form of a plate or sheet. It might have been advisable, however, to submit all the wires tested to a preliminary low-temperature annealing.

Professor T. Turner said that the general conclusion to be derived from the paper was that non-ferrous metals, as a class, were very resistant to corrosion and that the length of life might be measured in lifetimes rather than in months or years. Experience had shown, however, that brass wire and sheet deteriorated with great rapidity. A common example was picture wire in the ordinary atmosphere of a living room, and it was found that brasses that were lower in copper were the more ready to deteriorate in that way than 70/30. It would therefore be interesting to have a comparison with 60 or 64 per cent. copper/brass because it was perfectly certain that the corrosion would be even more rapid than was suggested by the results in the paper. For picture wire we should have at least 70/30 metal, and preferably the wire should receive a certain amount of gentle annealing before it was used. From the paper it would rather appear that brass, in ordinary circumstances, was more resistant to atmospheric corrosion than, as a matter of fact, was actually the case.

Dr. Hudson, replying to the discussion, said that he himself had suggested, as mentioned by Dr. Vernon, that all the wires should have a low-temperature annealing to relieve the internal strain, but the industrial members who were interested in that work said that they would prefer the wires to be tested in the actual condition in which they would be used in commerce. That seemed to him the more reasonable thing to do, because, if annealing had been resorted to, the previous history of the material was not known and the previous history was of great importance. As to the 70/30 brass mentioned by Professor Turner, he agreed that if brass was to be used under conditions in which it was liable to atmospheric corrosion, it was advisable to have a 70/30 or one with even a lower zinc content.

A paper by Dr. W. H. J. Vernon and L. Whitby on "The Open-air Corrosion of Copper, Part II.," was then read.

### THE OPEN-AIR CORROSION OF COPPER.

The composition of patina from copper structure of various ages in representative localities has been critically examined by the authors with a view to ascertaining whether definite formulæ could be ascribed to the principal constituents. Complete agreement with the formula of the corresponding mineral has been realised in products after seventy year's exposure and upwards. Basic copper sulphate—under most conditions the major constituent—then coincides in composition with brochantite, $CuSO_4.3Cu(OH)_2$; basic copper chloride—in products near the seaboard—with atacamite, $CuCl_2.3Cu(OH)_2$; basic copper carbonate—usually present but in minor proportion—with malachite, $CuCO_3.CU(OH)_2$. After shorter periods of exposure the basicity of the product is lower than that of the corresponding mineral.

Dr. Harold Moore said that the suggestion of identity of composition in minerals and in corrosion products was new to him, but it was extremely interesting. The authors had referred rather airily to the theory of co-ordination and apparently assumed that everybody was perfectly familiar with it. He had been asking two chemical friends if they knew what it was, and they said they did not, and he had been hoping that Dr. Vernon would explain it. The authors, again, did not say very much as to why corrosion products should resemble minerals. Metals existed in Nature in combination with non-metals, usually oxygen or sulphur or both. By more or less violent methods, we persuaded them to leave those low companions because we found them much more useful in their metallic state. The metals were then exposed to atmospheric and other conditions, and as a result they wished to return to their former companions. Oxygen was always present, and we obligingly supplied the sulphur by burning coal. It would be interesting to have the views of mineralogists on that matter, because it seemed that, by the process he had outlined, without any special knowledge of the subject, the metals reverted more or less to their original state.

Dr. W. Rosenhain said that he gathered that the identification by the authors of the corrosion products with certain minerals was based purely on chemical analysis, but a mineral was something more than a chemical compound. It generally had a perfectly definite crystallographic structure and it would be interesting to know not only whether the chemical analogy but also the crystallographic analogy exists. The study of corrosion should be made from the point of view of the power of the metal to resist the natural tendency towards the formation of corrosion products rather than from the point of view of the reason why corrosion products formed. That seemed to him to be the natural process. It would also be interesting to know whether, in the authors' view, corrosion ceased altogether when the constancy of chemical composition, to which reference was made in the paper, was reached.

Dr. Vernon, in the course of his reply, said that he hoped that Dr. Rosenhain would have had something to say about the co-ordination theory, because it was so intimately bound up with the question of the space lattice. It was a difficult thing to explain without diagrams. He agreed with Dr. Rosenhain that it would be desirable to examine the crystal structure, but he had not had the facilities to do that. At the same time it was striking how the constancy of the chemical composition was obtained which seemed to be definite evidence that the actual mineral was formed. At the same time, the X-ray structure would be of great interest in confirming that. The point as to when the corrosion ceased, or, if it did cease, when the constancy of composition to which he had referred was reached, was a very cogent one. He attributed the fact that there was that constancy of composition largely to the insolubility of the film product. The very existence of copper products pointed to the fact that the products were extremely insoluble. When once formed, if they did not stop corrosion altogether, they reduced it to a very low rate.

The following two papers were then presented and discussed together:—"Silicon-Copper Alloys and Silicon-Manganese-Copper Alloys," by Dr. E. Voce; "A New Silicon-Zinc Alloy," by E. Vaders.

### COPPER ALLOYS.

This paper records a survey of silicon-copper and of silicon-manganese-copper alloys, studying their mechanical and physical properties in the cast, drawn, and rolled conditions, with a view to developing and extending their uses. Their resistance to

* No. II. appeared September 19th.

corrosion has received attention, especially in the light of the development in America of alloys of copper with silicon and manganese in connection with chemical plant.

### A NEW SILICON-ZINC-COPPER ALLOY.

The author has determined the range of the α-solid solution phase at the copper end of the diagram, and it is shown that the 90 per cent. copper alloy can take up 4·5 per cent. silicon into solid solution. Earlier investigators considered 2 per cent. silicon to be the maximum solid solubility in this alloy and regarded all alloys with more silicon than this as brittle and therefore useless. The present work shows, however, that alloys with 2–5 per cent. silicon and 70–90 per cent. copper have valuable properties. The best alloys within this range are those with 80–82 per cent. of copper; these can be forged hot, rolled and extruded and give good castings in chill, sand or pressure moulds. The cast alloys have a dense uniform structure free from shrinkage cavities even in the thickest parts. In the cast state the tensile strength exceeds 50 kilos. per square millimetre with an elongation of 10–15 per cent.; after forging or drawing these figures rise to 65–85 kilos. per square millimetre and 30–10 per cent. respectively. According to the state of the alloy, whether cast, pressed, or drawn, the hardness varies from 120 to 170. The alloys are suitable for the manufacture of bearings and bells. For the latter purpose they give results equal in every way to those obtained with a good tin-bronze.

Dr. H. W. Brownsdon, discussing Dr. Voce's paper, said that it could be regarded as throwing some useful light on the part played by silicon in alloys of that element with copper, and also in conjunction with manganese. It was very easy to be wise after the event, but he was certain that if Dr. Voce had to repeat that work he would probably have followed somewhat different lines. In the first place, it was of the utmost importance to have the element which was being studied as pure as possible to ensure that there were no disturbing influences owing to the presence of small quantities of other elements, and for that reason it was unfortunate that a purer silicon was not used for some of the earlier experiments. Certain of the results obtained on the silicon-copper alloys, therefore, probably did not give a true picture of the effect of silicon alone. As to the ternary alloys with manganese, a review of the effect of the manganese alone in the absence of silicon would have been a valuable intermediary stage before considering the ternary alloys. He could not help feeling that the original excellent object of the paper had not entirely been fulfilled, and that the results arrived at might have been somewhat different if certain precautions had been taken. Work of the nature described in the paper was of the greatest importance in the development of alloys having properties specially developed for specific applications, and if all possible care and precautions were taken it would constitute a standard for reference. The microscopic examination might have been extended, with advantage, to the cold-worked fully annealed products, as it was not improbable that some of the properties of the ternary alloys might be due to the presence of manganese silicide. Dealing with one or two practical aspects of the paper, Dr. Brownsdon asked Dr. Voce if there had been any trouble in the drawing of wire, owing to scoring. Personally, he had found it necessary to remove mechanically the film of silica deposited on these alloys after annealing and pickling. Again, it had appeared from the paper that the sheets used by the author were not all of the best quality, and he imagined that they were badly spilly. He had experienced a similar trouble in the manufacture of sheets and tubes, from alloys containing silicon, and it appeared that some means of casting so as to obviate turbulence, such as the Durville method, might be an advantage in obtaining clean ingots. The season cracking tendencies of silicon-copper alloys were very marked, and it would appear from Dr. Voce's work that nothing short of complete annealing would entirely remove them. It would have been an advantage to know whether manganese had a beneficial influence in that direction. He was surprised to find the statement that the scale formed on silicon-copper alloys was firmly adherent, as his experience had been that, with de-oxidised coppers, such as those must be, the oxide scale was much less adherent than was the case with pure copper.

Referring to Dr. Vader's paper, Dr. Brownsdon said that it was unfortunate that the author had not made reference to the work of Gould and Ray, recently published in America, who had given a fairly clear idea of what was to be anticipated by adding silicon to the copper-zinc alloys. Those workers had examined the properties of several silicon brasses, to which increasing quantities of silicon had been added, with interesting results on the properties. With 1½ per cent. silicon there was an increase in elongation; with 2½ per cent. there was a decrease; and the figure remained steady then up to about 4½ per cent. silicon, the tensile strength gradually increasing. With further addition of silicon there was a rapid falling off both of elongation and tensile strength, and the American workers had traced those changes to phase changes taking place in the constitution of the alloys. The alloys became modified by heat treatment, and, if quenched in water and reheated, a slight increase in hardness might be obtained, reaching a maximum at about 500 deg. Cent. From the data obtained on a limited number of alloys, Gould and Ray had put forward a provisional idea of an equilibrium diagram. They had also reviewed the corrosion properties of the alloys, and stated that silicon in percentages lying within the range of good mechanical properties had apparently little effect on the corrosion resistance of the brasses. The addition of small quantities of silicon to brass reduced the viscosity of the molten metal and produced a fine dense structure in the cast alloy, giving clean sound castings. It hardened the alloy, and, in limited quantities, improved tensile strength at the expense of elongation. The alloys were hard, both in the cast and annealed state, so that they were not suitable for any considerable amount of cold working. Again, it had been shown that the presence of silicon increased liability to season cracking, and it was doubtful whether the silicon brasses were likely to replace the commonly used high-tensile brasses which, owing to their lower copper content, must always be cheaper. Unfortunately, concluded Dr. Brownsdon, advantageous modifications of properties in one direction generally led to disadvantageous modifications in some other direction, so that many alloys were a compromise between ideal and realisable characteristics, and the silicon brasses might have to come within this category.

Dr. W. Rosenhain, F.R.S., said that a valuable research had been carried out by the British Non-ferrous Metals Association, in which it was shown that, as the American work referred to had indicated, the easiest way to discover the useful and promising alloys in a complex system of this kind was on the basis of the microstructure. That report, however, was apparently still lying in the archives of the Non-ferrous Metals Research Association, and he must not say anything about it, although he wished it could be published.

Dr. F. Johnson, referring to the purity of the materials used by both authors, said that he was not sure that it was a disadvantage to ascertain the properties of such alloys as those in the presence of such impurities as were likely to be encountered when put into industrial use. Work which he had carried out in 1913 with ferro-silicon in connection with arsenical copper gave results comparable with some of those given by Dr. Voce, and it was a good point in favour in the use of silicon that it did not interfere with the rolling or working properties of the alloy at all. As regarded the silicon brasses, neither Dr. Vaders nor the American workers referred to had mentioned the likelihood of lead causing deterioration and difficulty in working. He did not think that lead was present in the brasses made by Dr. Vaders nor in those used by the American workers, and it would be interesting to have some information on that point, because many of the alloys would have to be hot worked, and it was in that connection that some trouble would be encountered. A point not mentioned by Dr. Voce was the extremely clean surface of the silicon-copper as cast. Those alloys, however, piped very definitely, and he would like to know whether the unsoundness to which Dr. Voce had referred was due to internal shrinkage or to non-metallic inclusions.

Professor T. Turner, discussing the question of the purity of metals employed in Dr. Voce's experiments, said that it was six years ago that that work was started, and it was possible that a purer silicon was available now than then. Considerable correspondence was entered into with regard to the samples obtained, and all he could say was that the purest silicon then obtainable was used.

Dr. Voce, in the course of his reply, also dealt with the question of the purity of the silicon and said that some twenty-four samples were analysed, but none had less than about 3 per cent. of iron. About halfway through the research it was ascertained that Dr. Rosenhain at the National Physical Laboratory had devised a method of purifying silicon by treating it with sulphuric and hydrochloric acids. He put a quantity of silicon through that process and used it for the second part of the research. He had not found any trouble in wire-drawing, because he did not draw any wires from anything containing more than 1 per cent. silicon, and with that percentage there was no difficulty. He certainly had not been altogether satisfied with the castings he made, and possibly something like the Durville process would have improved matters. In reply to Dr. Johnson's last question, he said that he thought that casting troubles were mainly due to inclusions. Although the materials responded to the mercurous nitrate test, they did not actually season crack over a considerable period. Whether they would have done so, given time, was doubtful, and certainly to remove the tendency to respond to the mercurous nitrate test for season cracking required a considerable amount of annealing, much more than just the ordinary low-temperature annealing required by brass.

Mr. Vaders promised to reply in writing.

Mr. H. C. Dews then presented a paper entitled "The Effects of Phosphorus on the Strength of Admiralty Gun-metal."

### PHOSPHORUS IN GUN-METAL.

The author of this paper has investigated the effect of phosphorus up to 0·131 per cent. on the tensile strength, elongation, Brinell hardness, density, and microstructure of sand-cast Admiralty gun-metal, particular attention being paid to the effect of casting temperature on the alloys. It is shown that phosphorus up to approximately 0·05 per cent. has little effect on the mechanical properties of structure of Admiralty gun-metal. Above 0·05 per cent. phosphorus causes the appearance of free $Cu_3P$ and at the same time a reduction in the mechanical properties.

Dr. O. F. Hudson said that Admiralty gun-metal was one of the most important non-ferrous metals, and that the author had done good service in bringing forward information showing the useful limit to the amount of phosphorus which might be present in it.

Mr. Wesley Lambert said that phosphorised gun-metal, so-called, was nowadays in more or less general use as a commercial foundry alloy, and although the matter had received little publicity, it had received considerable attention from certain works metallurgists. There were two points upon which he would like some enlightenment from the author. First, as regarded the method of compounding the several alloys mentioned. The copper was first charged and melted, and then the zinc, phosphor-copper, lead and tin were added. Why not have melted the copper and phosphor-copper together or, alternatively, have preceded the addition to the molten copper of the zinc by the phosphor-copper? Secondly, he would like to know why the author used an unofficial form of test bar. As a member of the sub-committee or panel for framing the B.E.S.A. specification for Admiralty gun-metal, it behoved him to draw attention to that. He entirely agreed with the author that a large proportion of the published data on bronze was of less value than it might be, and that was particularly so with regard to published tensile test results. Many of those results were entirely misleading owing to the investigator's lack of knowledge of the foundry technique required to cast a series of uniformly comparable test bars even from the same pot of metal. He had discussed that matter with the author on several occasions and the assurance he had been given that the best foundry technique had been followed in the tests, backed by the knowledge that the author was an experienced works metallurgist, gave every confidence in accepting his test results without hesitation. He was pleased to offer, for what it was worth, his own confirmation that phosphorus in excess of 0·035 per cent. in Admiralty gun-metal afforded no improvement in the mechanical properties of the alloy, particularly so in those alloys which had a lead content of the order of half of one per cent.

Mr. H. H. A. Greer asked whether the author could tell, after the casting has been made, what effect the phosphorus had had on the metal, apart altogether from the tensile strength. Did it affect the soundness, and if on the surface of the casting there were pitting or blow-holes, could the author tell whether they were due to the phosphorus? Another point was that he supposed even the author was sometimes forced to use scrap metal. That had to be done in Scotland, because so many people came to Scotland expecting to get a casting of Admiralty quality at 6½d. per pound. Therefore they were sometimes compelled to use a little bit of scrap metal, although perhaps the customers were told that nothing but virgin metal was used. The point, however, was how could it be traced whether there was phosphorus in the scrap metal and what methods could be adopted to keep the phosphorus out in order to supply castings at 6½d. per pound and perfectly sound in all respects? Referring to Table II. in the paper, Mr. Greer said that from the fact that the maximum stress in the case of one set of experiments varied from 12 to 17·6 tons and the elongation from 22 per cent. to 8 per cent. suggested there must be something else affecting the results more than the phosphorus was. It might be the heat as well as the phosphorus. In the case of another set of experiments the tensile strength varied from 11·2 to 17 tons and the elongation from 7 to 22 per cent. Yet another set of experiments related to a metal containing very low phosphorus, and although the figures of tensile strength and elongation were more even he was inclined to think that the temperature was, at any rate partly, responsible for the low tensile and elongation figures and that they were not due entirely to the phosphorus.

Mr. T. H. Turner asked for information for the benefit of founders who were accustomed to call virgin copper the material from locomotive fire-boxes. In some foundries locomotive fire-box material was regarded as the purest possible material and the arsenic was ignored. In Table I. the percentages of arsenic were considerably lower than was customary in many thousands of tons of castings being made at the present time. As perhaps other than railway foundries were in the habit of melting up that type of copper for castings, that were nominally Admiralty quality, he would like to know whether percentages of arsenic of the order mentioned in Table I. masked the influence of the phosphorus or what was the connection.

Mr. A. A. Walker asked how the author etched his specimens. He had found that a modification of the Stead tint method was the only one to show whether it was copper phosphide or some alpha material that had got into the delta complex. With Mr. Lambert, he would have preferred the author to add the phosphor-copper after the copper and not after he had melted the other constituents. Also, did the author really think that the reduction in mechanical properties was due to the free copper phosphide which was apparently shown in the photo-micrographs?

Mr. R. Genders, referring to the influence of casting temperature, said that, with a low temperature, a low tensile strength was obtained, and that suggested the use of a high casting temperature. That, however, was associated with porosity, whilst low casting temperature was associated with inclusions of some kind or another, possibly oxide inclusions. That led to the suggestions that, possibly, with other methods of casting better results might be obtained with the lowest possible casting temperature. He had proved

that in his own work, because, by the use of suitable methods, it was possible to cast brass to give the optimum properties at only a few degrees above the freezing point of the alloy.

Mr. F. Hargreaves said that there was no mention in the paper of roughness or splitting on the sides of the test pieces, yet he thought it must have occurred. Had the author ever seen a really sound gun-metal casting, and by soundness he meant one that was microscopically sound? It was possible to get good tensile and elongation figures, but when the surface was examined by a hand lens the rounded edge of the crystallite was observed, indicating that there had been no actual join between crystal and crystal. That made him think that if a really sound gun-metal casting could be obtained very much improved results would follow. Personally, however, he had not seen one.

Dr. F. Johnson asked if the author had encountered inverse segregation in taking analyses of the bars and would he indicate where and in what manner he took his drillings.

Mr. Dews, in his reply, said that he had found that chromic acid in a dilute solution of sulphuric acid, applied to the specimen after etching with whatever reagent might be used, brought out the copper phosphide very clearly. In the photography of specimens of that nature it was very necessary to use a colour screen. He did not know if Mr. Walker used a colour screen.

Mr. Walker said he used a yellow screen.

Mr. Dews remarked that probably better results would have been obtained with a green screen for bringing out the copper phosphide. The question of the order of adding the materials mentioned by Mr. Wesley Lambert had been a matter of disputation for a long time, and, personally, he wondered whether there was much in it. If new materials were being used, the matter might be important, but, if part new metal and part scrap were used, then there was no choice as to the order in which the constituents were added. From old scrap brass, providing the analysis was correct, it was possible to get as good results as with all new metal or part scrap and part new metal. Therefore, the order of adding the constituents did not appear to be very important. In the case of the research mentioned in the paper, he added phosphorus after the zinc for a very definite reason. Copper alone contained oxygen, and it could not be prevented from taking up oxygen during melting. If the phosphorus was added first, a lot of it was lost. If the zinc was added first a little of it was lost. His aim was to retain the phosphorus in the alloys so that he more or less deoxidised the copper with the zinc first and then added the phosphorus. There was certainly a loss of phosphorus, but nothing like to the extent there would have been if he had added the phosphorus before the zinc. He apologised for using an unofficial test bar. The reason was that it was a bar he was used to and, moreover, at the time the tests were carried out, the B.E.S.A. specification had not been issued. The question of being able to tell, from the casting, what effect the phosphorus had had was a matter of experience. In an Admiralty gun-metal which had an excess of phosphorus the fracture would be very badly discoloured and in a rather different way from the discoloration of a casting that was porous through other causes such as shrinkage. The discoloration extended over the whole section of the fracture, and the grain size was often very much smaller than in a casting which was free from phosphorus. Again, the facets of the grains on the fracture were all more or less evenly discoloured. Excess of phosphorus could also be detected by the skin of a sand casting, because there was a tendency for it to bite into the sand more than when the metal was free from phosphorus. Normally, it would not be found that there were blow-holes owing to the phosphorus unless the material had been cast at a very low temperature. His own firm used scrap metal, but only that made in their own works. As a matter of fact, in the making of gun-metal castings it was quite common to obtain 30 or 40 per cent. scrap in the runners and risers and it necessarily had to be used up. It could not be thrown away or sold. Therefore, in his own works it was regularly used without any ill effects. In any case, if precautions were taken to see that the analysis of scrap metal was correct no harm could be done. The whole point of carrying out the tests was to show up the effect of casting temperature, and to show how difficult it was to dissociate the effect of casting temperature from the effect of impurities. As to locomotive fire-box material being regarded as virgin metal his firm certainly would not consider it so. With regard to arsenic, it would be found that a very large majority of Admiralty gun-metal castings normally contained percentages of arsenic of the order mentioned in the paper. It was not stated in the paper, but it seemed that the deleterious effect of phosphorus over 0·5 per cent. was due to the appearance of free copper phosphide. It was a rather complicated matter, and he would not like to say, definitely, that the deleterious effects were associated with the appearance of this free copper phosphide. He did not altogether agree with Mr. Genders that some of the low results were due to non-metallic inclusions at low casting temperatures. He believed that they were also due to porosity, and that was experienced with both high or low casting temperatures. There was no splitting or cracking of the sides of the test pieces, as suggested by Mr. Hargreaves, and he would not have expected it. Contrary to Mr. Hargreaves, too, he had certainly seen gun-metal castings which he knew were sound, because they had been tested under high-pressure steam or water at 2000 lb. or 3000 lb. per square inch. Moreover, the fact that many of those castings had been in use for long periods without showing signs of leakage was sufficient indication that they were sound. In reply to Dr. Johnson, he did not look for inverse segregations, but he would have been extremely surprised if there had been any. As to drillings, the test bars were drilled from one side to the other and any inverse segregations would have been taken care of in the drilling.

Mr. Greer asked the author if he could suggest any flux that would eliminate phosphorus from a metal, or was it only possible to reduce the phosphorus content by the addition of metals which were known not to have any phosphorus in them.

The author said that he believed the latter was the only commercial method.

Mr. D. Stockdale then presented, "A Note on the Constitution of the Cadmium-zinc Alloys."

### THE CADMIUM-ZINC ALLOYS.

Recent work on the constitution of these alloys has indicated that Jenkins has underestimated the mutual solubilities of the two metals. The author finds that zinc is somewhat more soluble in cadmium than Jenkins has shown, but there is exact agreement about the constitution of the zinc-rich alloys. The discovery that certain of the alloys partially liquefy on a falling temperature has been confirmed.

Mr. F. Hargreaves asked the author whether he had formed any opinion as to the reason for the change indicated in his paper and whether he thought that zinc was allotropic.

Mr. Stockdale said that there seemed to be no X-ray evidence at all in favour of the allotropy of zinc, although there was a good deal of other evidence in that direction.

The next paper was one entitled "Heat Treatment, Ball Hardness and Allotropy of Lead," by Mr. F. Hargreaves.

From consideration of quenching and ball-hardness tests on lead of high purity, the author suggests that lead is allotropic, the suggested critical points being 187 deg. Cent. and 228 deg. Cent. approximately. The hardness varies greatly with the heat treatment. Very marked changes take place in the hardness immediately after quenching. The presence of 0·005 per cent. tin inhibits these marked changes and they do not take place in commercially pure lead. Each sample tested shows increased hardness resulting from quenching.

In presenting the paper Mr. Hargreaves mentioned that some of the later experiments in the paper were carried out upon some very pure lead obtained from the National Lead Company of America, which gave an analysis of 99·99941 per cent. lead.

Dr. Walter Rosenhain said that the author had been pursuing a rather lonely furrow in the study of lead and soft metals, and although some of his conclusions might be disagreed with, or even some of his experimental facts questioned, there was no doubt that he had called attention to interesting questions which had not hitherto received from others the attention they deserved. The first point about the paper was the question of the use of hardness testing as a research method. Personally, he did not think hardness testing was a satisfactory method of investigation from the point of view of studying the constitution or changes of structure, allotropic or otherwise, of metals or alloys. His reason for saying that was by no means due to prejudice, but was due to the fact that hardness was not a simple or definite property of a material, but was dependent, in the values obtained even with the harder and more stable metals, on the method of testing employed. No really satisfactory definition of hardness had yet been given. It was at all events a complex property, and his view was that we should get to our objective much more quickly and with greater certainty by dealing with the single physical constants, There were, for instance, tensile strength and such properties as thermal behaviour of the metal, and, perhaps most fundamental of all, there was the question of electrical conductivity, so that he did not feel satisfied that the hardness test was a satisfactory one. Indeed, the data in the paper really confirmed that view. Further, he was not at all clear that the curve drawn by the author was the only possible or right interpretation of the figures he had obtained. The suggestion that the metal underwent allotropic change might or might not be right, but it was a question of what was meant by allotropic change. That was a most important and fundamental question. Personally, he suggested for careful consideration the adoption of the definition for allotropy that it meant changes in which a change in lattice could be established. At the same time, he agreed with the author that further investigation by X-ray methods was necessary, but personally he would be surprised to find that there was a change in lattice in the case of lead. That, however, was a matter for experiment, and if there was no change of lattice, how could the change of properties mentioned in the paper be explained? The feeling he had from the data in the paper was that the lead was undergoing something in the nature of a precipitation phenomena.

Mr. F. H. Edwards said that he was engaged at the works of the National Lead Company of America when the very pure lead mentioned by the author was made. It was deposited from a fluoborate solution. It was re-dissolved and re-deposited, and it was the fourth deposition which was sent to Mr. Hargreaves, 1000 grammes were taken for analysis, which was supplemented by spectrographic analysis carried out by Dr. St. John, of New York. That entailed the National Lead Company making chemical analyses and giving them to Dr. St. John as standard for further work.

Dr. H. O'Neill said that the author had at least established that there was something queer about lead, and he also had to be congratulated on getting a specimen of such purity. Whilst agreeing with Dr. Rosenhain, he relied on the author's skill in testing soft metals in basing an opinion that something had happened, and there was confirmation of that idea from experiments carried out by Cannegieter—not mentioned in the paper—which indicated that there was a transition point of some kind at 182 deg. Cent. That work was done by a thermal method, a piece of lead wire being used on one side of a thermo-junction. The same work, however, did not get any such result at other temperatures.

Mr. Hargreaves, in reply, said that the point he wished to bring out was that the hardness change very often took place to a far greater degree than any other physical property, and that was the real use of the hardness test. He agreed with Dr. Rosenhain's definition of allotropy, and mentioned that there was no reference in the analyses of the lead obtained from America to oxygen. He had often wondered whether the change noted was due to oxygen, but having worked on samples many times, he came to the conclusion that it did not matter very much.

Mr. F. H. Edwards said that there were 4/10,000th of oxygen in the sample of lead sent to Mr. Hargreaves by the National Lead Company of America, as against 2/1000th in ordinary commercial lead.

The remainder of the papers on the programme, which were not presented, owing either to the absence of the authors or lack of time, were taken as read, and the meeting closed with a cordial vote of thanks to the Mayor and Corporation of Southampton, the many firms which had so kindly given facilities for inspection of works, &c., the Admiral Superintendent of Portsmouth Dockyard, the Cunard Steamship Company, the Southampton Tramways Committee, the Southampton Harbour Board, and the Committee of the Royal Southampton Yacht Club, for many facilities, whilst last, but not least, a cordial vote of thanks was passed to Councillor Woolley, the hon. local secretary, and his helpers for the admirable manner in which they had organised the arrangements in Southampton.

Luncheon was taken on R.M.S. "Mauretania," by invitation of the Cunard Steamship Company, after which the vessel was inspected and visits were paid in the afternoon to various works.

On Friday, September 12th, a choice was offered of two all-day excursions, namely, a New Forest and an Isle of Wight trip, whilst arrangements had also been made for a trip to France over the week-end.

## International Agricultural Tractor Trials.

No. II.*

THE organisers of the trials were very fortunate in having at their disposal such a vast tract of agricultural country as that lent by Mr. A. T. Loyd at Ardington, near Wantage, for public demonstration purposes. The land is chiefly stubble after wheat and beans, and of fairly uniform consistency, and the arrangements made by the Institute of Agricultural Engineering, Oxford, left little to be desired on the part of the competitors. Most of the ploughs employed were lent for the purpose by Ransomes, Sims and Jefferies, Ltd., Ipswich, and Frederick Howard, Bedford. After the strenuous tests of the machines which were carried out in June last it was not to be expected that last week's operations would present any serious troubles, and when our representative attended on Tuesday the work that was being done was uniformly excellent. Although there was present a large number of representatives of the farming industry, there was a noticeable absence of the crowds of sightseers who have hitherto been present on such occasions.

It is a matter for regret that British engineers are still backward in attacking the agricultural motor problem. Although there are several machines built in this country, out of all the competitors there were too few which could claim to be purely British in invention, design and manufacture—a state of affairs which is discreditable, and it is to be hoped will not endure much longer. The present tests have proved beyond doubt that there is great scope in this direction for a simple and reliable crude oil engine.

On pages 338, 339 and 342 we give illustrations of several of the machines which may be considered fairly representative. Fig. 6 is the International "Farmall" tractor, made by the International Harvester Company of Great Britain, Ltd., City-road,

* No. I. appeared September 19th.

London. This is of the wheel type with a draw-bar rating of 9 horse-power and 18 horse-power belt rating. It operates on paraffin after starting on petrol and has a four-cylinder engine with a bore 3¾in. and stroke 5in., the normal crank shaft speed being 1200 revolutions per minute. The ignition is by magneto with impulse starter, the lubrication is by gear pump and splash, and the cooling is on the thermo syphon principle. There are four road wheels, two being drivers and there is a three-speed gear-box and single-plate clutch. The travelling speeds are 2, 3 and 4 miles per hour forward and 2½ miles per hour reverse. The weight is 4120 lb. and the vertical height of the draw-bar 6½in. In the tests the maximum horse-power delivered was 20·9 on the belt and 13·8 on the draw-bar, and the fuel consumption at rated load 0·77 lb. per horse-power hour on the belt and 1·23 lb. on the draw-bar.

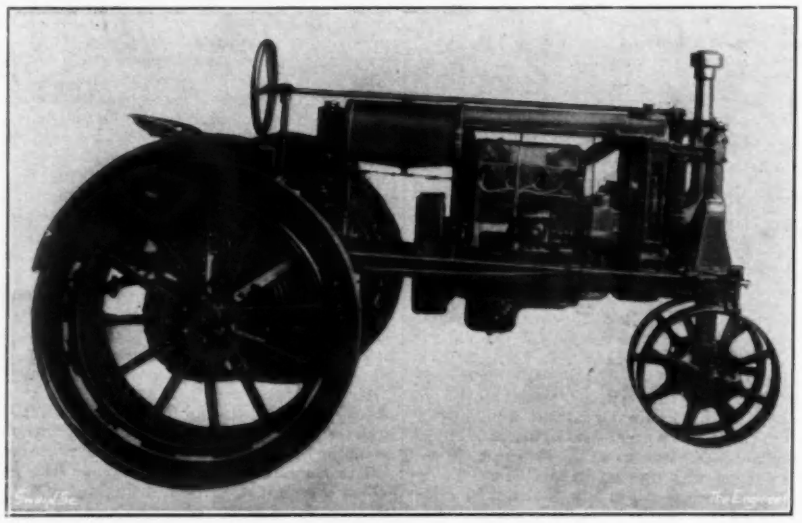


FIG. 6—PARAFFIN TRACTOR—FARMALL

The tractor shown in Fig. 7 is made by Marshall, Sons and Co., Ltd., Gainsborough, and the single-cylinder injection engine has a 16 horse-power rating on the draw-bar and 24 horse-power on the belt. The bore and stroke of the engine are 8in. and 10½in., the compression ratio 15½ to 1, and the crank shaft speed 550 revolutions per minute. The engine is started by a torch and the fuel is supplied by a pump. The engine has a shaft governor and the cooling is by a fan and pump. There are four road wheels, two being drivers, 46½in. diameter and 12in. wide. There is a three-speed gear-box and multi-plate clutch, the travelling speeds being 1¾, 3 and 5 miles per hour. The weight is 6990 lb. and the vertical draw-bar height 15in. On the tests the engine gave a maximum of 29·1 horse-power on the belt and 21·4 on the draw-bar, the fuel consumption being 0·50 lb. per horse-power hour and 0·82 lb. per horse-power hour respectively.

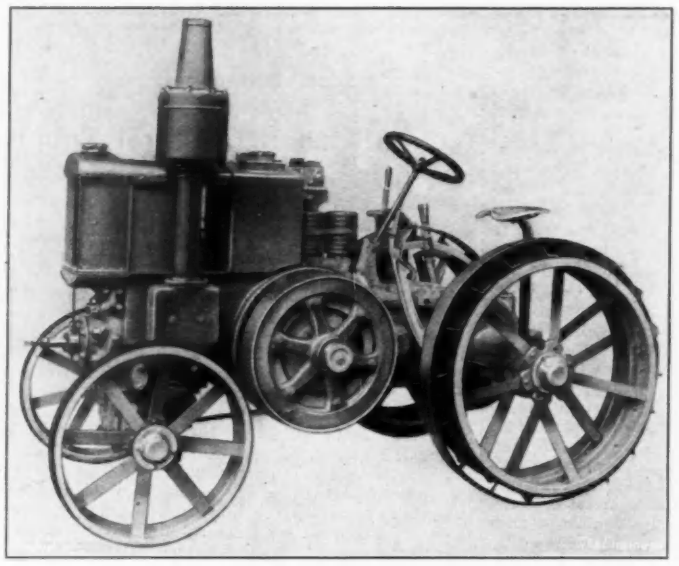


FIG. 7—FUEL-OIL TRACTOR—MARSHALL

The Lanz "Bulldog" tractor shown in Fig. 12, p. 342, is made by Heinrich Lanz Aktiengesellschaft, Mannheim. The engine is of the single-cylinder horizontal type having a draw-bar rating of 15 horse-power and belt rating of 30 horse-power. The bore and stroke are 8·85in. and 10·2in., the compression ratio 6·5 to 1, and the crank shaft speed 540 revolutions per minute. Hot bulb ignition with fuel supplied by a pump, centrifugal governing and thermo syphon cooling are employed. The driving wheels are 45in. diameter and there is a three-speed gear-box and three-jaw clutch with automatic safety release. The travelling speeds are 2, 3·25 and 4 miles per hour forward and 2·1 miles per hour reverse. The draw-bar is vertically adjustable between 16in. and 20in. In the tests the maximum horse-power delivered was 31 on the belt and 23·2 on the draw-bar, and the fuel consumption 0·74 lb. and 0·86 lb. per horse-power hour respectively.

The Linke track-laying tractor shown in Fig. 13, p. 342, is made by Linke Hofmann-Buschwerke-Aktiengesellschaft, Breslau. The engine operates on petrol and has a draw-bar rating of 35 horse-power, while the power on the belt is 45 horse-power. There are four cylinders, 4 5/16in. and 6 5/16in. bore and stroke, and the compression ratio is 5·1 to 1; the crank shaft speed being 1100 revolutions per minute. Ignition is by magneto. The two tracks are 11 13/16in. wide and 20ft. long, the length on the ground being 46in. and the area of ground contact 543 square inches. There is a three-speed gear-box, single-disc clutch and the road speeds are up to 5 miles per hour. The weight is 7620 lb. and the maximum power delivered on the tests was 47·6 on the belt and 34·2 on the draw-bar. The fuel consumption was 0·74 lb. and 1·02 lb. per horse-power hour.

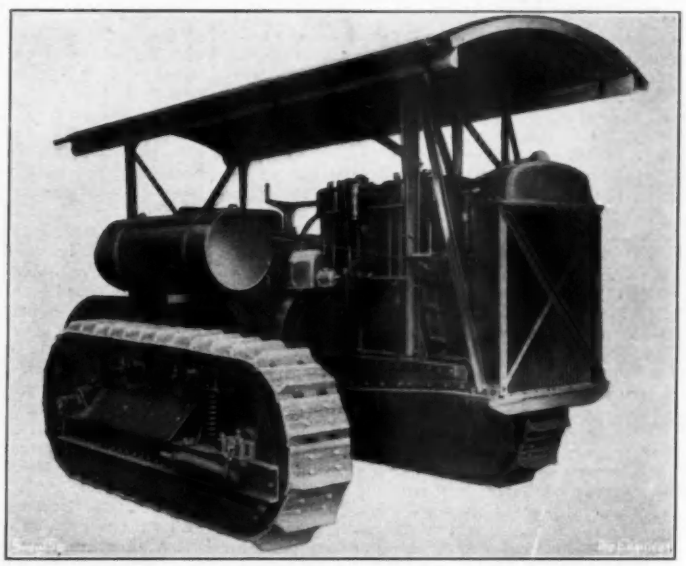


FIG. 8—PETROL TRACTOR—CATERPILLAR

The Rushton track-laying tractor shown in Fig. 14, p. 342, has a four-cylinder petrol engine giving 28 horse-power on the belt and 18 on the draw-bar. The engine has four cylinders, 4·14in. and 4·97in. bore and stroke, with a compression ratio of 4·76 to 1 and a crank shaft speed of 1200 revolutions per minute. The two tracks are 13in. wide and 216in. long, the length on the ground being 32in. and the area in contact 415 square inches. There is a three-speed gear-box and multi-plate clutch and the weight is 5650 lb. The draw-bar has vertical adjustment between 10¼in. and 16¼in. The travelling speeds are 1·58, 2·60 and 4·31 miles per hour, and 1¾ miles per hour on the reverse. On test the engine gave 32·2 horse-power on the belt and 24·7 horse-power on the draw-bar, while the fuel consumed at the approximate rated load was 0·73 lb. per horse-power hour and 1·04 lb. respectively.

Two tractors of Swedish design and manufacture made their first appearance in this country at these trials, although they have been on the market for some time in Sweden. The makers are Munktells Mek. Verkstads Aktiebolag. Eskilstuna, who claim to have had many years' experience in the building of farm tractors. Both machines are alike in their general features, but the engines are of different dimensions, one having a draw-bar rating of 15 horse-power and the other of 20 horse-power. Our illustration—Fig. 9—shows the principal parts of the larger machine, which has a vertical twin-cylinder, two-stroke, hot-bulb engine with crank-case compression, and compressed air starting mechanism. The cylinders are 7 3/16in. bore by 8in. stroke; the compression ratio is 6 to 1, and the crank shaft speed 650 revolutions per minute. The ignition is by a hot bulb and the fuel is supplied by a pump. The hot bulbs are heated in two or three minutes by means of built-in burners using the same crude oil from which the power is generated. The compressed air required for the burners is obtained from a vessel which is charged up automatically from the rear cylinder. When the bulbs are sufficiently hot compressed air is admitted by a starting valve to the front cylinder for starting purposes. The crank case, which also constitutes the front end of the tractor, is of ample dimensions. The rear part of the crank case is made to form a cowl for the large fly-wheel, and the front truck is bolted on to the front end. The crank case is provided with two large hand holes on each side, and these give access to the crank bearings, &c. The cylinders are cast in one block, which is bolted on to the crank case. The ignition devices are fitted at the upper end of the water-cooled cylinder head, and the bulbs are so designed that after starting up no lamps are required.

The crank shaft runs in ball and roller bearings, and the counterweights are proportioned to balance the reciprocating parts effectively. The purifier for the scavenging air is of rather novel construction. It consists of a sheet iron cylinder with perforated ends, fitted with small sheet iron rings, which are kept in a sticky condition by immersing them in oil. During the zig-zag passage of the air through and around these sticky rings, all particles of sand and dust are arrested. To clean the purifier it is rinsed in paraffin and is then dipped in oil again. The air intake valves in the crank case consist of thin rings of nickel steel and are wholly encased so as to muffle the noise caused by the passage of the air.

The engine is water-cooled by radiator, fan and gear-driven pump. Lubrication to all parts is effected mechanically by means of an immersed pump, which has neither valves nor springs. Facilities are also provided for feeding the oil to the different parts by hand if required before starting, or during running. The fuel is injected into the combustion chambers in an atomised condition by means of two fuel pumps, which are fitted on and driven by a centrifugal governor placed on the gear-box and driven from the crank shaft by bevel gearing. The governor regulates the stroke of the pump plungers and thus the quantity of fuel in relation to the load on the engine and maintains the engine revolutions constant. No manual regulation of the speed is necessary, and the driver can thus devote his whole time to steering.

The gear-box constitutes the rear section of the tractor body and contains the whole of the transmission mechanism, which consists of spur gearing of nickel steel. There are three forward speeds—2·25, 2·90 and 3·90 miles per hour—and a reverse gear of 1·68 miles per hour. The weight of the machine is 6830 lb. and the draw-bar has vertical adjustment between 9in. and 16·6in. During the test

this tractor delivered 35·2 horse-power on the belt and 21·1 horse-power on the draw-bar, the fuel consumption at the approximate rated loads being 0·68 lb. per horse-power hour and 1·05 lb. at the draw-bar.

J. and H. McLaren, Ltd., Leeds, entered two tractors with four-stroke engines. The smaller tractor—Fig. 15—has a draw-bar rating of 14 horse-power and a belt rating of 20 horse-power, the engine being a single-cylinder horizontal with a bore and stroke of 5·9in. and 9·45in. respectively, the compression ratio being 15·6 to 1, and the crank shaft speed 800 revolutions per minute. The power is transmitted through a single-disc dry clutch and a three-speed gear-box, the road speeds being 1·9, 2·8 and 3·85 miles per hour, while the reverse speed is 2·5 miles per hour. The weight of the machine is 6100 lb. and the draw-bar height 15in., with 8in. vertical adjustment. The maximum power delivered on the belt was 23·9 and on the draw-bar 13·7 horse-power, while the fuel consumption at the approximate rated load was 0·52 lb. per horse-power hour on the belt and 0·81 lb. on the draw-bar. The engine is started by a torch. The other machine shown by Messrs. McLaren had a draw-bar rating of 16 horse-power and a belt rating of 27·5 horse-power. The engine has two cylinders, 5·3in. diameter by 7·9in. stroke, the compression ratio being 15 to 1 and the crank shaft speed 800 revolutions per minute. Ignition is by compression of the charge and the fuel is supplied by a pump. Lubrication is by pressure, and a governor of the centrifugal type is fitted. Transmission is by a three-speed gear-box and a single dry plate clutch, the travelling speeds being 2·1, 2·86 and 6·40 miles per hour forward and 3 miles per hour reverse. The weight of this machine is 6090 lb. The vertical height of the draw-bar is 14¾in. During the tests the maximum power delivered on the belt was 30·5 horse-power and on the draw-bar 19·2 horse-power, while the fuel consumption at the approximate rated load was 0·57 lb. per horse-power hour, and 0·79 lb. per horse-power hour respectively on the belt and on the draw-bar.

The Caterpillar Tractor Company, San Leandro, California, had five entries the largest of which gave 59·3 horse-power on the draw-bar tests and 66·7 horse-power on the belt. At the demonstrations at Ardington this machine hauled two five-furrow ploughs simultaneously with ease. It is propelled by a four-cylinder petrol engine with a bore and stroke of 6¼in. and 8½in., a compression ratio of 3·86 to 1, and a crank shaft speed of 650 revolutions per minute. The cooling is by thermo-syphon and fan, and the ignition is by high-tension magneto. The three-speed gear-box gives travelling speeds of 1·9, 2·6 and 3·7 miles per hour forward and 1·4 miles per hour in the reverse. The transmission is taken through a dry plate master clutch and the steering is by multiple dry plate clutches. The two tracks are 16in. wide and 72in. between the centres, so that the length of track on the ground is 79½in., and the area of contact 2544 square inches. The width between the tracks is 50in. and the turning circle 12ft. 1½in. The weight of this machine is 8½ tons. During the tests all these machines worked very satisfactorily, and the fuel consumption for the largest at approximate rated load was 0·74 lb. per horse-power hour on the belt and 1 lb. on the draw-bar. The smallest machine with a draw-bar rating of 10 horse-power weighs just under 2 tons, and the area of ground contact is 817 square inches. An illustration of the 60 horse-power machine is given in Fig. 8.

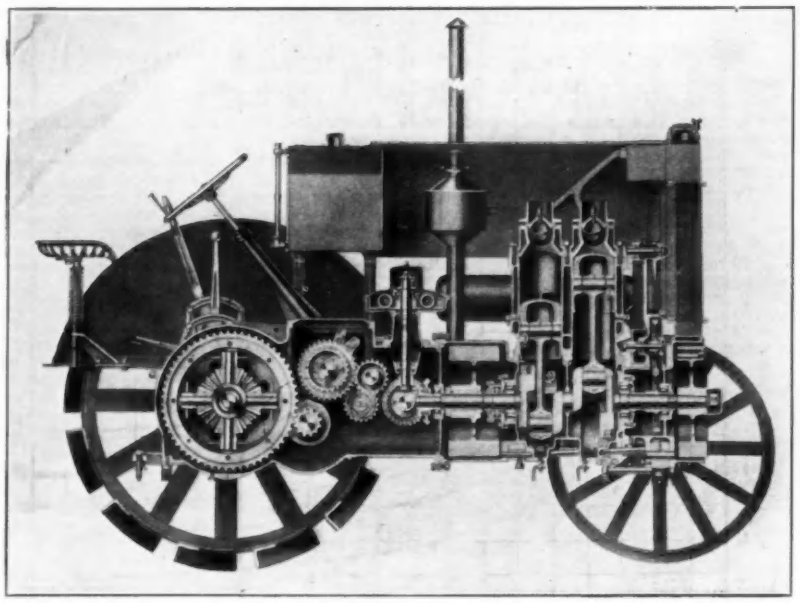


FIG. 9—FUEL OIL TRACTOR—MUNKTELL

A four-wheel driven machine was entered for the tests by Latil Industrial Vehicles, Ltd., Albert Embankment, London, S.E. 11. One of the special features of this tractor are the six-speed gear-box, giving road speeds from 2·30 to 17 miles per hour forward and two low reverse speeds. The tractor is propelled by a four-cylinder petrol engine with a bore and stroke of 3·54in. and 5·12in. respectively. The compression ratio is 4·5 to 1, and the crank shaft speed 1900 revolutions per minute. Another novel feature of this tractor is the pneumatic shod wheels, fitted with special folding spuds. The object of the makers of this tractor is to provide a machine that is equally useful on both the roads and on the land. The maximum power delivered by this tractor on the belt was 28·2 horse-power and 19·8 on the draw-bar. The petrol consumption was 0·79 lb. per horse-power hour at the approximate rated load.

The Citroën Kegresse tractor has a petrol engine of 12 horse-power draw-bar rating. It is of the track-laying type with two steering wheels. The tractor weighs 3810 lb. and the two tracks have an area of ground contact of 378 square inches. The tractor has a six-speed gear-box, the travelling speeds being 0·93, 1·62, 3·02, 4·5, 7·9, and 14·6 miles per hour.

The Hofherr-Schrantz-Clayton-Shuttleworth tractor made in Budapest has a horizontal single cylinder "hot-bulb" engine, with a belt rating of 30 horse-power. It has a bore and stroke of 8⅛in. and 9⅞in. respectively, a compression ratio of 5·5 to 1, and the speed of revolution is 575 per minute. Hot bulb ignition, fuel pump, Bosch central lubrication, and shaft type governor are other features of this engine. The power is transmitted to the road wheels by two-speed gear-box and cone clutch, the travelling speeds being 2½ and 3½ miles per hour. This tractor weighs about 3 tons and the driving wheels are 43in. diameter by 12in. wide. The fuel consumption worked out at 0·64 lb. per horse-power hour at the approximate rated load and 1·26 lb. on the draw-bar.

Agricultural and General Engineers, Ltd., Aldwych, London, had two entries, one a 20 horse-power Blackstone tractor—Fig. 10—and the other by Aveling and Porter—Fig. 11. In both cases the engines are of the four-cylinder vertical type. The Blackstone machine delivered 37·7 horse-power on the belt and 27 horse-power on the draw-bar. It has cylinders 4¾in. bore by 6in. stroke, and a compression ratio of 14 to 1, the crank shaft speed being 1000 revolutions per minute. In this engine the fuel is supplied to each cylinder by separate injectors on the top. The transmission system includes a multi-plate dry clutch and a three-speed gear-box, the travelling speeds being 2·75, 3·19, and 5 miles per hour. The weight is 7300 lb. The fuel consumption at the approximate rated load was 0·52 lb. per horse-power hour on the belt and 0·84 lb. on the draw-bar. In the case of the Aveling and Porter tractor, the compression ratio is rather less than in the Blackstone machine, while the engine speed is rather higher. The transmission system includes a three-speed gear-box and plate clutch, and the weight is the same as Blackstone's tractor. The consumption tests were extremely satisfactory and the weight per draw-bar horse-power below the average in its class.

In the market garden cultivator section there were three machines entered by Geo. Monro, Ltd., Waltham Cross. There were the Monotrac cultivator with a single-cylinder two-stroke engine of a nominal rating of 3½ horse-power, starting and running on petrol; the Duotrac cultivator, with a single-cylinder, 2¾ horse-power petrol engine; and the Rototiller, with a single-cylinder, 5 horse-power petrol engine. The tests on these machines were carried out in May, and consisted of 40 hours' ordinary cultivation work under market garden conditions. As its name implies, the Monotrac machine has a single travelling wheel, and the report on its working states that it is well suited for hoeing between two rows. It produced its best work in even and well-tilled soil, and the engine has ample power. The Duotrac, according to the report, is quite suitable for any cultivation between rows, and is easy to manipulate; while in the Rototiller tests the engine worked well and the machine generally substantiated the claims made for it. It is capable of doing a good range of market gardening operations. On market gardens the use of these handy machines will replace a large amount of hand labour.

In concluding our report on these trials, we feel that a few words of appreciation are due to the Institute of Agricultural Engineering at Oxford University for the fair and thorough manner in which they were conducted, and for the copious report which has been drawn up on them. We would strongly advise every

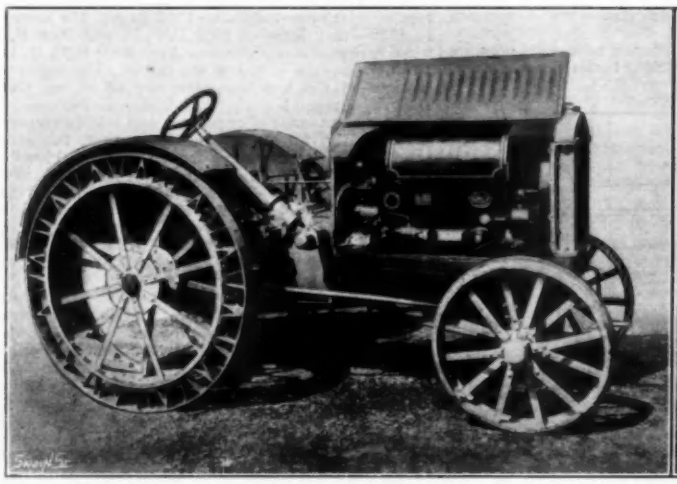


FIG. 10—FUEL OIL TRACTOR—BLACKSTONE

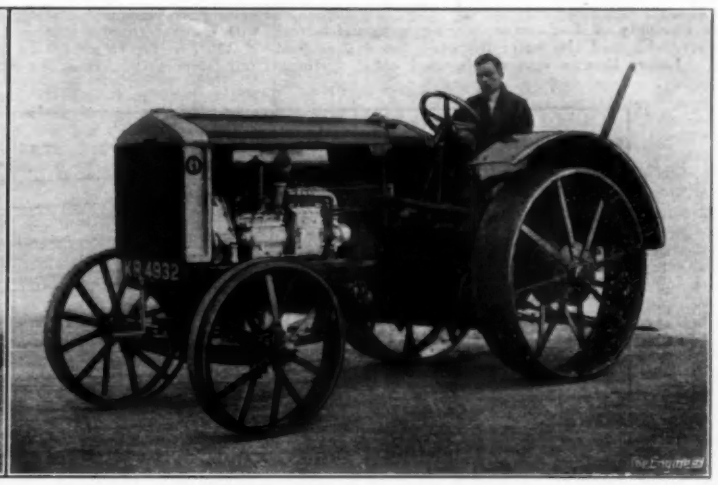


FIG. 11—FUEL OIL TRACTOR—AVELING

interested farmer to obtain a copy of this report. Although it only gives the costs of working as regards fuel and lubricating oil persons interested will be able to arrive at the total cost of tractor working by including allowances for interest on capital, depreciation, repairs, and labour.

Such tests should go a long way towards producing confidence in the capabilities of such machines, the use of which will greatly assist the agricultural industry by speeding up seasonal work and reducing manual labour.

## The Use of High Pressures and Temperatures in the Generation of Power.*

By GEO. A. ORROK.

THE early successful steam engines of Newcomen, Smeaton and Watt were atmospheric engines, and the power obtained was largely due to the action of the vacuum. Watt's improvements and the standard working of the next half century led to the use of pressures of 10 lb. per square inch to 20 lb. per square inch. Inventors and constructors, like Hornblower, Trevithick and Evans, had dared to construct machines using pressures of 5 atmospheres to 10 atmospheres, claiming economies over the lower-pressure engines, but their work produced only a ripple in the general practice, since the theory of engine efficiency had not yet been formulated.

It was in 1824 that Sadi Carnot produced the paper "Reflexions sur la Puissance Motrice du Feu," which was to clarify all our ideas on the efficiency of heat engines, and it was about this time that many experiments began to be made with higher pressures, to better the economy of machines producing power through the use of heat. Indeed, in 1822, Jacob Perkins used steam at 50 atmospheres, and two years later had designed a steam generator, which was actually operated at 4000 lb. per square inch and temperatures up to 1000 deg. Fah. It had been known, even in Watt's time, that "the high-pressure engine consumed less fuel than a condensing engine of the same power, and that the force of the steam per square inch increases in a much greater ratio than the temperature communicated to the water" (Galloway, 1836), but a whole century was necessary to raise steam pressures generally to 150 lb., and 20 years more before 200 lb. became the standard pressure for power production.

Meanwhile, Carnot's paper had been discovered, and his law applied to our conceptions of efficiency. Superheaters had been invented, discarded, and again applied, and the invention of commercial turbines by Parsons, De Laval, Rateau and Curtis had shown the way to increased efficiency to be obtained by the use of higher pressures and temperatures. This wave of progress resulted in the installation of many high-pressure plants, of 400 lb. about 1918, 600 lb. about 1922, and 1200 lb. to 1400 lb. about 1924, while experimental plants at 1800 lb. and 3200 lb. are now running in every-day commercial service. Total steam temperatures have been rising from about 400 deg. in 1905 to 750 deg. to-day, with experimental plants at 850 deg. and 950 deg. in every-day service, and at least one experimental plant at 1000 deg. in operation. In the United States alone, there are 20,000,000 kW of installed machinery up to 500 lb., 1,350,000 kW running between 500 lb. and 800 lb., and 270,000 kW from 800 lb. to 1400 lb., with a few kilowatts of experimental machinery working at higher pressures.

The economy of feed-water heating was understood by Watt, who used the water from the hot well as feed water. Later, Bourne and others used other systems, and in America, Thurston, Stanwood and Nordberg carried the regenerative system to its logical conclusion for steam engines, heating the feed nearly to the saturation temperature by bleeding between the cylinders. Shortly after the commercial turbine appeared, Ferranti applied the regenerative cycle to the turbine, and this principle has been one of the chief factors in the increase of station economy in the last 30 years. Such being the state of affairs at the present time, what may be said for the economies which have been due to these great increases in the operating pressures and temperatures of our generating stations?

Theoretical efficiencies are easily calculated from $\frac{3412\ T_c}{T_c - T^\circ}$ = B.Th.U. per kW-hour, the Carnot efficiency. Assuming a thermodynamic efficiency of 85 per cent., the turbine heat rates are shown in the dotted curves of Fig. 1, reproduced from a paper by the author presented to the Second World Power Conference, Berlin, 1930. If we allow a further 20 per cent. as a minimum for all other losses, including combustion, boilers, piping, and generator losses, the full-line curves show the best possible economy, under the assumptions, for the central station as a whole. This, however, is not enough; we know that partial loadings of units or stations lead to reduced economies, and this factor has been reflected in reported economies. The base-load unit with its best point about rating, the ordinary unit with its best point at the running point, say, 65 per cent. to 80 per cent. of rating, and the peak-load machine, with its best load at 50 per cent. or below of the rating, all show the attempt to secure maximum economy over a range. It is possible, however, to find an empirical formula connecting load factor and economy, and such expressions have been used by many engineers. They usually take the form—

$$\text{B.Th.U. per kW-hour} = C + \frac{A}{L\,F}$$

where C and A are constants and L F is the load factor, or more rigidly the "use" factor, in per cent. The term "use" factor here employed signifies the average load carried by the station divided by the 24-hour full-load capacity of the station. In the author's paper on "Water *v.* Steam Power," read before the Tokyo Sectional Meeting of the World Power Conference, in 1929, the expression $14{,}000 + \frac{100{,}000}{L\,F}$ = B.Th.U. was used for determining the economy of the steam station for comparison with the water-power station.

When we try to get such a formula to include pressure and temperature terms, the work is better done in steps, and the author's assistant, Mr. Artsay, has suggested the following as an expression for the best point—covering the range from 200 lb. up—of the unit :—

$$\text{B.Th.U's. per kW-hour} = 14{,}000 + \frac{7{\cdot}5\,(1000 - t)}{\sqrt{P}} - 673\,\sqrt[4]{P} - 196 = H_c$$

where

$t$ = temperature, total, in deg. Fah.
P = pressure, gauge, in pounds per square inch.
$H_c$ = B.Th.U's. base for load-factor correction.

The family of curves may then be calculated from—

$$H_{LF} = H_c + 500 + \frac{2000}{\sqrt{L\,F}} + \frac{80{,}000}{L\,F}$$

where

$H_{LF}$ = B.Th.U's. at any load-factor L F.
L F = percentage of possible load.

These curves have been plotted in Fig. 2, and show the best economy to be expected at 750 deg. total temperature for the chosen pressures and the range of use factors. The dotted curve crossing the field is the median curve of a field of yearly records of many central stations—about 500 points—which appears on page 351 of the last edition of *The Engineering of Power Plants*, by Fernald and Orrok. In all cases, the higher heating value of the fuel has been used as given by the calorimeter, and the kilowatt-hour "send out" of the station. The median line has a much higher slope, showing that, in general, station losses can be much better controlled at high use factors. It also shows that Hopkinson's "light running charges" category is fully as important to-day as it was in the early days of the central station, when Crompton and Wordingham stressed the need of a large divisor—*i.e.*, hours of use—to reduce unit costs, whether stated in terms of heat or money.

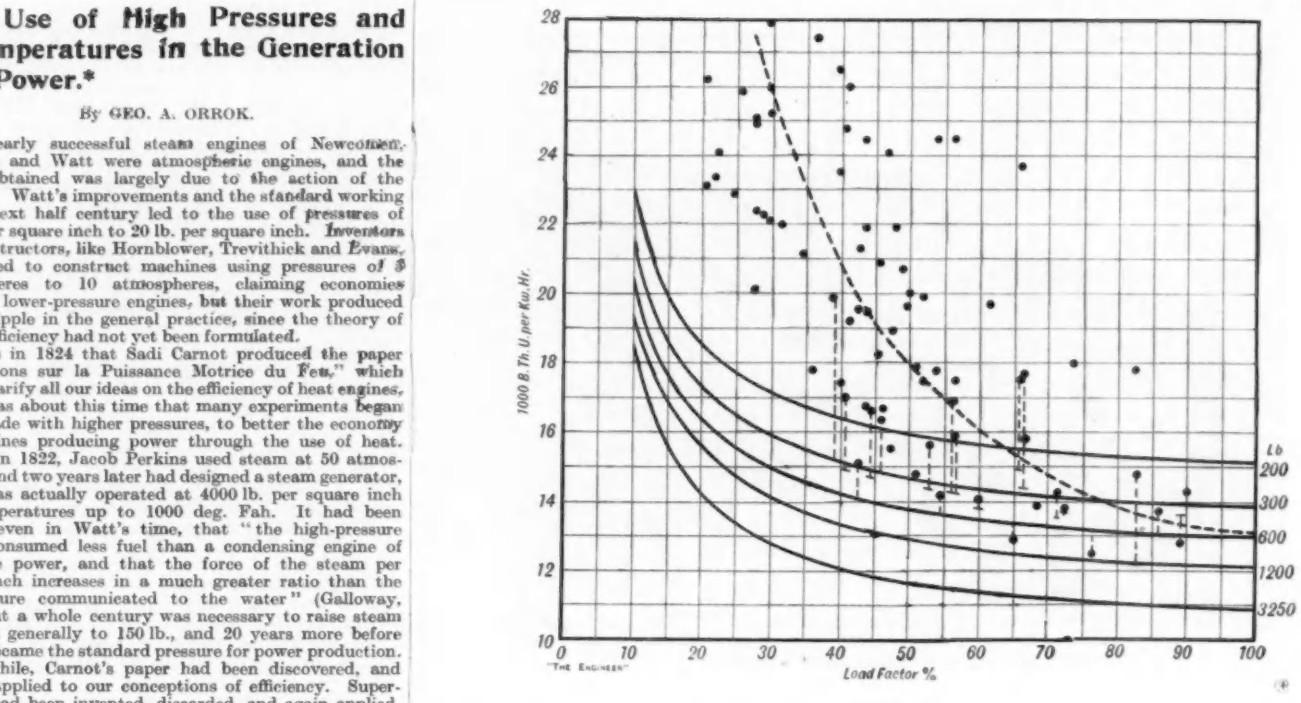



FIG. 1




FIG. 2

The shape and position of the curves show that the savings due to high pressure and temperature are real and of considerable magnitude. Comparisons between actual records and the curves show that the losses become much smaller as the use factor increases. It is probable that an increase of the use factor of 10 per cent. would present economies equal to doubling the pressure. In general, if any yearly station record be plotted on Fig. 2, and an ordinate be drawn from the point down to the curve of the station pressure, the length of the ordinate will represent the possible B.Th.U. per kilowatt-hour that may be saved by better machinery and improved operation at the given use factor. These ordinates for modern stations—300 lb. to 1200 lb. and the period 1925 to 1930—vary between 1000 B.Th.U. and 2000 B.Th.U., while earlier stations may run from 2000 B.Th.U. to 5000 B.Th.U., especially at low use factor. The high-pressure stations of the last few years are all within the 1000 B.Th.U. of possible saving with higher use factors.

Investment costs of apparatus and station construction vary greatly, but it would appear that, for American conditions, with pressures from 300 lb. to 1200 lb., 100 dollars a kilowatt of maximum 24-hour capacity is a fair figure to use. Reported high-pressure installations have cost about 6 per cent. higher, but it would appear that a newer installation would be somewhat cheaper. Personally, the author believes that this statement should hold up to the critical point, 3200 lb. From published reports, the maintenance and operating costs vary more between installations of the same pressure than any variation shown between high and low pressures. The hours of use and the price of fuel would then be the determining factors in the economies of power generation, but with a fixed fuel cost per million B.Th.U., station heat rates would decrease :—

(1) As the use factor increases. This would be the largest variation, and would follow the curves in Fig. 2 quite closely.

(2) As the pressure increases. Roughly 1000 B.Th.U. saving for each doubling of the pressure, starting with 200 lb.

(3) As the increase in total temperature. Roughly 200 B.Th.U. saving for each 100 deg. rise of temperature above 500 deg. Fah.

(4) As the quality of operation improves. A decrease of 1000 B.Th.U. to 5000 B.Th.U. between good and poor operation.

Reference to Tables I. and II. reproduced in connection with the World Power Conference, Berlin, paper may be made for a list of the high-pressure stations in America.

* British Association, Section G. read September 9th, 1939.

A NEW WELDING ELECTRODE.—A new welding electrode, called "Cresta," has been brought out by Alloy Welding Processes, Ltd., of Walthamstow. We are informed that very remarkable elongation has been obtained in the tests which have been made with this electrode. In twelve test pieces the elongation obtained between points 1in. apart, *i.e.*, covering the weld metal, the elongation never fell below 33 per cent., and it reached as high a figure as 36 per cent. This elongation was gained with an entire absence of porosity. The tensile strength is 27–28 tons. The company claims that an electrode is now available which can be safely used for the electric welding of pressure vessels.

## Railway and Road Matters.

THE Northern Counties Committee of the London, Midland and Scottish Railway has, in succession to Mr. W. K. Wallace, who has been made chief stores superintendent to the L.M.S. Company, promoted Mr. H. P. Stewart to the vacant position of locomotive and permanent way engineer.

THE absorption by the Great Western Railway on August 4th of the Corris Railway, as recorded in this column on August 29th, has led to the Central Wales division of that line having four different gauges under its control. There is, of course, the standard 4ft. 8½in., the Vale of Rheidol—from Aberystwyth to Devil's Bridge—1ft. 11½in., the Corris of 2ft., and the Welshpool and Llanfair of 2ft. 6in.

ONE of the many items of early railway history which the recent Liverpool and Manchester Centenary has brought out is that, as indicated in a letter from Mr. B. Welbourn, of Rainhill, in *The Times* of September 17th, the celebrated skew-arch bridge at that place was built by George Findlay, the father of Sir George Findlay, one of the famous managers of the London and North-Western Railway.

THE winter train services came into operation on Monday, September 22nd. There is little change from the corresponding programme of a year ago. The "Flying Scotsman" will cease to run non-stop between King's Cross and Edinburgh, and *vice versâ*, and the Cornish Riviera Express will again call at Exeter. On all the railways, except the Southern, a large number of stations and some branch lines are being shut down for passenger traffic.

THE locomotives that have been on exhibition at Wavertree in connection with the centenary have been taken to Manchester and are to be shown on No. 10 platform for ten days from yesterday, Thursday. This is in accordance with the desire of the London, Midland and Scottish Company to give the Manchester people, especially the children, an opportunity of seeing these interesting exhibits while the object of the celebrations is still in mind.

COLOUR blindness, usually of a minor degree, is often met with in candidates for employment in railway service and leads to their failure to be accepted. That a similar weakness must prevail among the drivers of motor vehicles is fairly obvious, and it is instructive to hear that in some flashlight signals for the protection of road traffic at a railway level crossing at Stettin in Germany the white flashes, which indicate that no train is approaching, are forty per minute, whilst the red flashes, showing that a train is in the section, are eighty per minute.

THE Belfast correspondent of the *Manchester Guardian* tells of an interesting development in transport in the suburban area of that city. A monopoly of the street transport has been given to the Belfast Corporation, and the opening of new bus routes has been restricted. The railway companies, concurrently, have purchased about eighty of the bus services in the areas serving Belfast and have since been allowed to increase the fares. A combine of bus users has now been formed which will own buses and run them for the sole use of the members of the combine. As these vehicles will thus be privately owned, they will be outside the monopoly of the Corporation.

THE railway between Portland and Easton was completely blocked for 5 hours on Thursday, September 11th, by a fall of rock. This line is equipped with an arrangement of signals that give "danger" indications should such an obstruction occur. The stones, on their way on to the line, break a run of wires and so release the signals from their normal indications of "clear." That installation was not, however, the first such contrivance, as, at least forty years ago, there were fixed a series of such signals in the Pass of Brander, by the side of Loch Awe, on the Callander and Oban, to guard against trains running into stones that fell down the slopes from Ben Cruachan.

THE Ministry of Transport railway statistics for June have just been published as a Stationery Office publication, price 3s. 6d. A factor that must be remembered in their connection is that the Whit-week traffic fell in June this year, but in May in 1929. That, no doubt, accounts for the increase of 4 per cent. in the number of journeys, when compared with June, 1929. The journeys made at ordinary fares decreased by 2·84 per cent., but day and half-day excursions rose by 16·34 per cent., and the week-end bookings by 27·59 per cent. The receipts from passengers increased by 8·2 per cent., and it is a satisfaction to record that the passenger train mileage increased by only 2·4 per cent. The tonnage of freight traffic fell by 15·05 per cent., of which general merchandise was 10·17 per cent. down, minerals and classes 1 to 6 of merchandise 17·27 per cent., whilst coal, coke and patent fuel, having a decrease of 2½ million tons, suffered a fall of 15·79 per cent. Freight train receipts decreased 13·4 per cent., freight train miles 7·7 per cent., and the average train load, owing, no doubt, to the falling-off in coal traffic, fell from 128¾ to 120¾ tons.

THE celebrations in connection with the centenary of the opening of the Liverpool and Manchester Railway terminated on Saturday evening last. Except that the inclement weather, especially the deluge of rain and wind on the Wednesday, marred some of the outdoor display, everything was a great success. The last of the luncheons took place on Saturday, on which occasion Sir Josiah Stamp was in the chair, and Mr. George Lansbury represented the Government. A remarkable point made by Sir Josiah was the condition of trade when the Liverpool and Manchester was opened a century ago. "Times were difficult a hundred years ago; the mere records of history failed to convey the conditions of those days. Thomas Attwood, of Birmingham, declared that ironmasters and manufacturers generally were going to ruin. All trade from 1825 to 1831 had been carried on at a positive loss, and cotton mills had been sold or let for a fifth of their value, whilst Carr Glyn, the banker, spoke of depression among London traders." Proceeding, Sir Josiah said that it behoved all of us to make the most of the factors that were left us, and we certainly ought not to be bankrupt of courage and the spirit of adventure.

## Notes and Memoranda.

THE production of coal in New Mexico in 1929 amounted to 2,622,769 net tons, according to a statement just issued by the United States Bureau of Mines, Department of Commerce. In comparison with the previous year, this is a decrease of 89,082 tons, or 3·3 per cent.

MORE than 100 new exhibitors have already booked space in the Birmingham section of the next British Industries Fair, which is to be held from February 16th to 27th next. It is noteworthy that these exhibitors come from such widely spaced places as Kent and Scotland, Worcester and Bristol.

A MOTOR omnibus fitted with a high-speed Diesel engine by L. Gardner and Sons, Ltd., of Patricroft, Manchester, has been put on the road by the Leeds Corporation. It is claimed that this vehicle will travel at least twice the distance travelled by a petrol omnibus on a given quantity of fuel.

IT is claimed for Promal, a new form of malleable iron produced by the Link-Belt Company, of Indianapolis, United States of America, that it has an average yield point of 45,000 lb., as against 36,000 lb.; an average ultimate strength of 65,000 lb., as against 54,000 lb. per square inch; an average elongation of 14 per cent., as against 18 per cent.; and a Brinell hardness of 170 to 190, as against 110 to 130.

A STEEL truss, 90ft. long, 33ft. high, and weighing 312 tons, has, says *Steel*, been installed in the Waldorf-Astoria hotel, New York. The bottom cord is the first of eight steel sections 90ft. long and weighing 63 tons. Six sections vary in weight from 20 to 30 tons. The top cord is also 90ft. long and weighs 74 tons. The truss supports a portion of the building from the ninth to the forty-sixth floors, leaving a floor space of over 10,000 square feet free from columns.

RECENTLY, tantalum has been used successfully in the manufacture of spinnerets for the rayon industry. Not only does it resist corrosion, but since it can be coated with an electrolytic oxide of almost diamond hardness, there is no apparent wear or distortion of the holes through which the spinning solution is ejected. Like tantalum, the oxide coating is inert toward all chemical reagents except hot fused caustic, hydrofluoric acid, mixtures of hydrofluoric and nitric acids, and 95 per cent. boiling sulphuric acid.

A NEW style of roadway is to be made in Sangamon County, Illinois. It will have a carefully rolled and prepared sub-grade on which the steel base and kerb will be laid. Next will follow a mastic sand cushion upon which will be placed a layer of 2¼in. or 3in. brick, with an asphaltic filler poured into the interstices between the brick. The result will be an indestructible base with a smooth riding surface built into the structure with sufficient flexibility to meet all changes in temperature without breaks or cracks on the surface.

ACCORDING to Messrs. E. G. Mahin and E. J. Wilhelm, rapidly cooled lead is improved in respect of its resistance to corrosion by sulphuric acid by the addition of copper in proportions up to 1 per cent., but if its practical application involves continued heating, even at a temperature of 100 deg. Cent., the copper falls out of solid solution and it then may accelerate the acid attack. Under such heating conditions copper up to 0·20 per cent. improves the qualities of the lead, but beyond this limit it promotes destruction of the sheet by the acid.

AN invention for discovering and raising sunken submarines has recently been submitted to trial at Palermo. The device, which was invented by a Sicilian, Signor Simone Monasteri, is described as consisting of a double arrangement of fittings, one set to be attached to submarines and the other set to vessels engaged in salvage. The idea is that when a submarine founders, luminous buoys, attached by cords to the side of the vessel, will float to the surface of the water. The salvagers will detach these buoys and, by winding the cords into a metal cylinder fitted with rings, will let down the cylinder on to the sunken vessel. The rings, as they strike the submarine, are caught by hooks, by means of which the vessel would be hauled up by cables attached to the cylinder.

IN discussing the utilisation of waste sulphite liquor from paper pulp mills, the *Chemical Trade Journal* says that one of the most promising projects appears to be the conversion of the lignin substances in the waste liquor into a fuel. A number of Swedish organisations have requested the Swedish Parliament to appropriate 150,000 crowns (approximately £10,000) for the construction of an experimental plant, to use a modification of the German Bergius process for treating fuel oil from sawdust and waste sulphite liquor. This proposal has the endorsement of the Swedish chemical industry, the Technical University, and others. Dr. Bergius has offered to build such a plant at a cost of 95,000 marks. The consensus of opinion in Sweden, however, seems to be that the production of fuel substitutes is not practicable when the cost of coal is less than £1 4s. per ton.

SOME years ago a Berlin engineer, W. Kiwull, devised a method of sealing a leak on a ship by forming a coating of ice over the rent in the metal hull. A company was formed and plans for a test plant were made and elaborated by Escher, Wyss and Co., of Zürich. The test plant was to have a gross refrigerating capacity of 120,000 B.Th.U. per hour, and the power consumption was to be 25 horse-power. The specification stated that the plant was to be erected and worked at a depth of between 10ft. and 15ft. below the level of the Lake of Zürich. It was then to be worked for a fortnight without a hitch, maintaining its guaranteed output continuously. The refrigerating plant was contained in a water and air-tight iron casing, the electric connecting cables and the connecting branches for the evaporating apparatus coming through. Under these trying conditions, the plant operated at full load continuously for 336 hours, that is, fourteen days and nights. A careful examination showed that it had not suffered the least injury. Many thousands of readings were taken during the tests, and the results show that the minimum guaranteed output had been largely exceeded. From time to time the ice formation on the evaporative tubes was checked by divers.

## Miscellanea.

THE Russian Government has ordered no less than 456 Koppers coke ovens in America.

A NON-PROPELLING floating crane of 60 tons capacity is to be provided for Table Bay Harbour.

A NEW 60,000 lb. per hour Babcock boiler is to be added to the equipment of the Pretoria power station.

IT is proposed to construct a hydro-electric plant of 120,000 horse-power at Masson, on the Lievre River, in Quebec.

IT is intended to plant 136,000 hectares of land in Southern Russia with chondrilla plants for the production of rubber latex.

AN electrolytic copper refinery, with a capacity of 100,000 tons a year, is being put up at Sverdlovsk, in Russia. Its cost is estimated at 22 million roubles.

AFTER lying idle for about twenty years, the Wonder gold mine on the Pongola River, in Northern Natal, is to be restarted. At one time it paid a dividend of 52½ per cent.

THE electric power plant at Springs, South Africa, is to be reconstructed at a cost of £20,000, while that at Benoni is recommended for reconstruction at a cost of £41,850.

THE new steel bridge across the Vaal River at Christiana was opened towards the end of August. It is 1000ft. long, with a clearance of 54ft., and took two years to build. The cost was £37,000.

SIX surveying parties are working in the field along the Pongola River in Northern Zululand on a proposed irrigation scheme. It is intended to irrigate about 50,000 acres at a capital cost of a quarter of a million. The Union Air Force is assisting in the survey.

THE Staveley Coal and Iron Company, Ltd., is erecting a new foundry for the manufacture of pipes by a centrifugal process using a sand-lined mould. The erection of the plant is now well advanced, and it is expected that the new product will be on the market by the middle of 1931.

IT is reported that 600 tons of copper ingots have been recovered from the wreck of the Elder Dempster liner "Cariboo," near East London, South Africa, by the 1000-ton converted dredger "Kate." Work is about to be started on saving the remainder, another 600 tons, of this cargo.

THE Supreme Economic Council of Russia has, says the *British-Russian Gazette*, proposed to all organisations concerned that they should commence the construction of suitable living accommodation for "foreign engineers, foremen and qualified workmen," and it is apparent that every effort will be made to encourage foreign engineers possessing the required qualifications to go to Russia to take up positions there.

THE official returns rendered to the Electricity Commissioners show that 721 million units of electricity were generated by authorised undertakers in Great Britain during the month of August, 1930, as compared with 706 million units in the corresponding month of 1929, or an increase of 2·1 per cent. During the eight months of 1930 up to the end of August, the total amount of electricity generated by authorised undertakers was 6888 million units, as compared with 6536 million units for the corresponding period of 1929, representing an increase of 5·4 per cent.

THE establishment by the Association of Special Libraries and Information Bureaux, 26, Bedford-square, W.C.1, of a Panel of Expert Translators was publicly announced in June by means of a letter addressed by Sir J. J. Thomson to the Press and to many societies and institutions. The immediate result was a large number of inquiries from prospective users and translators. The latter, as a preliminary to registration, are required to answer a questionnaire and, at present, something over a hundred have sent in their completed forms. The work of examining the qualifications of applicants is being carried out as quickly as possible, and, already, by means of the Panel ASLIB is in touch with a very fine body of translators.

EXTENSIVE beds of potash, discovered in the north of Spain by prospectors of the Geological Institute, are said to have proved to be from 25ft. to 30ft. in thickness, and to lie at an average depth of about 300ft. from the surface. Some of the beds extend to a length of 1800ft. or more. The deposits lie in an area bounded by Burgos in the west, Lerida in the east, Logrono and Huesca in the north, and Saragossa in the south. The extreme length of the field from east to west is 250 miles, while the distance across varies up to about 80 miles. To prevent any speculative "ramp" and to protect the landowners and workers in the area, the Government has suspended the registration of mines throughout the field, and the State will exploit the deposits. These discoveries add considerably to the already considerable natural resources of Spain.

IT was reported at a meeting of the Special Works Committee of the Plymouth City Council on Monday, September 22nd, that the Ministry of Transport had sanctioned the borrowing of a further sum of £21,910 for the completion of the Embankment-road improvement. This final section of the scheme involves the reconstruction of the railway bridge at the eastern end of the Laira embankment, in respect of which an agreement with the Great Western Railway Company has been negotiated. When carried to completion this scheme will be the most costly road improvement ever undertaken by the Corporation, the total expenditure being in the neighbourhood of £150,000. It cost some £24,000 to purchase the embankment and its toll rights, £45,000 was paid for Laira Bridge, and £57,000 expended on constructing what is regarded as one of the finest stretches of road within the city boundaries. When Laira Lake is filled at high tide Embankment-road becomes a most pleasant water-front, and if anything comes of the suggested damming of the lake and the utilisation of its water power for the generation of electrical energy, this beautiful frontage of the Plym estuary is likely to become one of Plymouth's most popular promenades.

# INTERNATIONAL AGRICULTURAL TRACTOR TRIALS

(*For description see page* 337.)

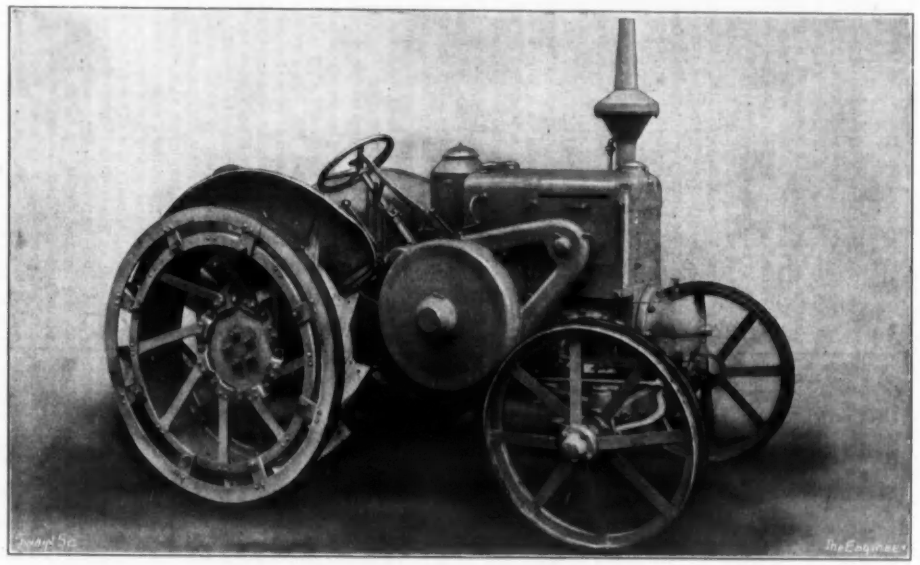


FIG. 12—FUEL OIL TRACTOR—LANZ

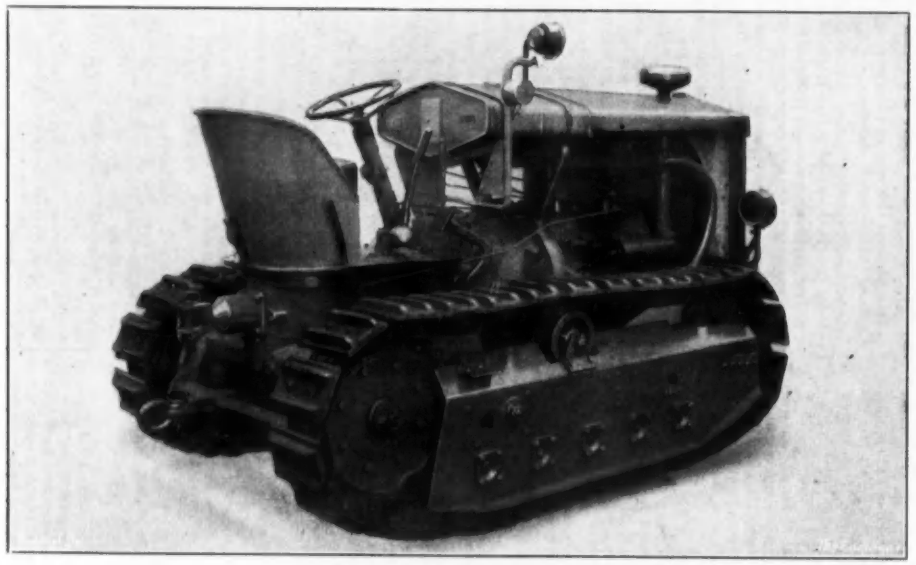


FIG. 13—PETROL TRACTOR—LINKE

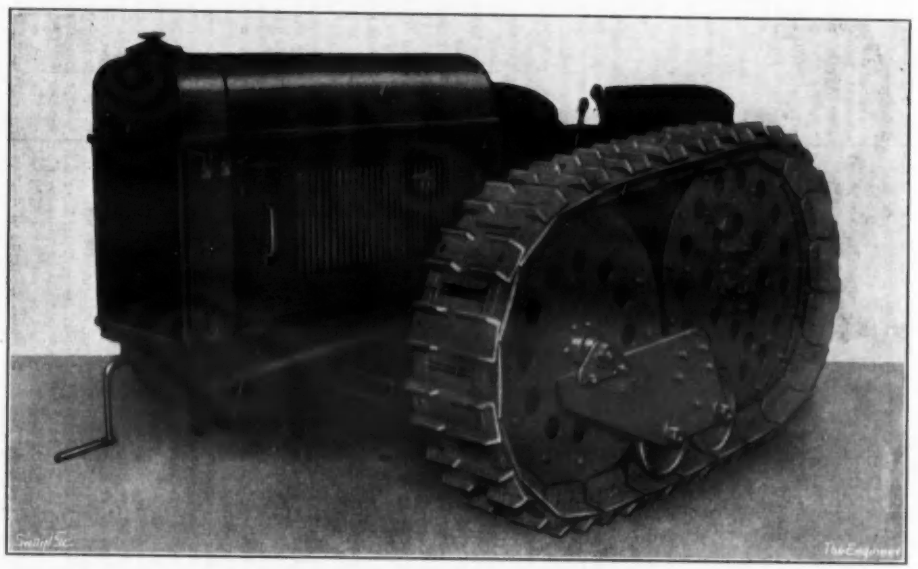


FIG. 14—PETROL TRACTOR—RUSHTON

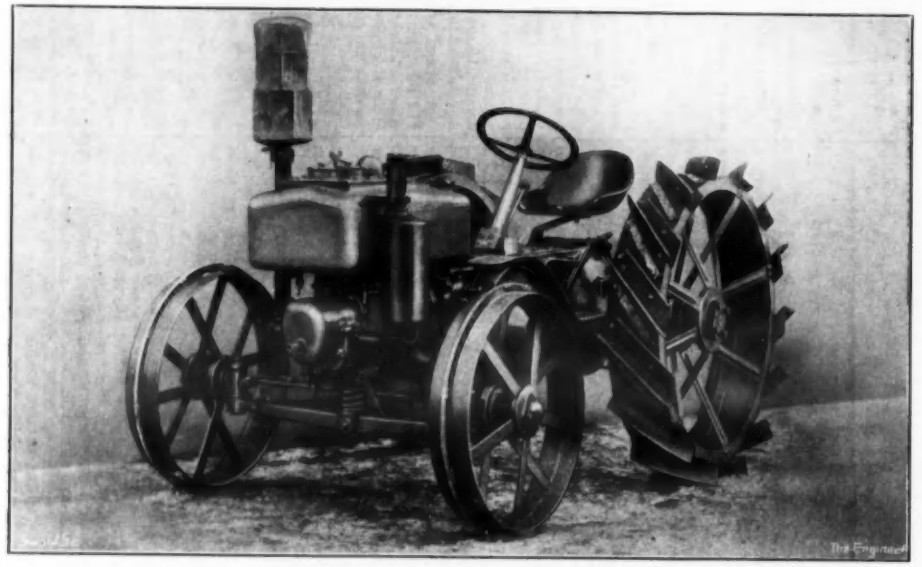


FIG. 15—FUEL OIL TRACTOR—MCLAREN

# The Engineer
## Annual Subscription Rates
**(including postal charges).**

Subscriptions will be accepted by the Publisher direct or through a newsagent at the rates and in the currencies stated below :—

| | | | | |
|---|---|---|---|---|
| **BRITISH ISLES** .. .. | £3 | 5 | 0 | |
| **CANADA** .. .. .. | £3 | 3 | 0 | Thick Paper edition. |
| | £2 | 18 | 6 | Thin Paper edition. |
| **ABROAD** .. .. .. | £3 | 7 | 6 | Thick Paper edition. |
| (except Canada) | £3 | 3 | 0 | Thin Paper edition. |

| | |
|---|---|
| AFRICA .. .. | Central News Agency. All Branches |
| * £3 7s. 6d. | CAPE TOWN : Wm. Dawson and Sons, Ltd., |
| † £3 3s. 0d. | 29–31, Long-street (Box 489) |
| | JOHANNESBURG : C. Juta and Co. |
| ARGENTINE .. | BUENOS AIRES : Mitchell's Book Store, 576 |
| * £3 7s. 6d. | Cangallo |
| † £3 3s. 0d. | |
| AUSTRALIA .. | Gordon and Gotch (Australasia), Ltd. All |
| * £3 7s. 6d. | Branches |
| † £3 3s. 0d. | MELBOURNE : Robertson and Mullens, |
| | Elizabeth-street |
| BELGIUM .. | BRUXELLES : W. H. Smith and Son, 78–80, |
| * Fr. 590 | Rue du Marché-aux-Herbes |
| † Fr. 550 | |
| CANADA .. .. | American News Company, Ltd. All Branches |
| * $15·25 | MONTREAL : Gordon and Gotch, Ltd., 334, |
| † $14·25 | Notre Dame-street, W. |
| | TORONTO : Wm. Dawson and Sons, Ltd., 67, |
| | Queen-street East |
| | TORONTO : Gordon and Gotch, Ltd., 81, |
| | Queen-street West |
| CEYLON .. .. | COLOMBO : Wijayartna and Co. |
| * Rs. 44·5 | |
| † Rs. 41·5 | |
| CHINA .. .. | HONG KONG : Kelly and Walsh, Ltd. |
| * $37 | SHANGHAI : Kelly and Walsh, Ltd. |
| † $34·5 | |
| EGYPT .. .. | CAIRO : Express Book and Stationery Store, |
| * £3 7s. 6d. (Pt. 330) | 9, Chareh Maghrabi |
| † £3 3s. 0d. (Pt. 308) | |
| FINLAND .. | HELSINGFORS : Akademiska Bokhandeln, |
| * M. 650 | Alexandersgatan, 7 |
| † M. 605 | |
| FRANCE .. .. | PARIS : Boyveau and Chevillet, Rue de la |
| * Fr. 418 | Banque, 22 |
| † Fr. 390 | PARIS : Librairie Berger-Leverault, 229, Bld. |
| | St. Germain |
| | PARIS : Brentano's, 37, Av. de l'Opera |
| | PARIS : Dunod, 92, Rue Bonaparte |
| | PARIS : W. H. Smith and Son, 248, Rue de |
| | Rivoli |
| GERMANY .. | BERLIN–LICHTERFELDE–WEST : H. Her- |
| * R. mks. 70·00 | manns, Dahlemer Strasse 64 A |
| † R. mks. 65·00 | WESTERN GERMANY : Fritz Rehfus, Blumen- |
| | thalstrasse 10, Cologne |
| | LEIPZIG : K. W. Hiersemann, Konigstrasse 29 |
| HOLLAND .. | ROTTERDAM : Hector's Boekhandel, Noord- |
| * Fl. 41·00 .. | blaak 59 |
| † Fl. 38·00 | ROTTERDAM : Techn. Boekhandel, "Plan C," |
| | Gelderschestraat 4 |
| INDIA .. .. | BOMBAY : Thacker and Co., Ltd. |
| * Rs. 45 | CALCUTTA : Thacker, Spink and Co. |
| † Rs. 42 | |
| ITALY .. .. | MILAN : Ulrico Hoepli |
| * Lire 300 | ROME : Maglioni and Strini, 307, Corso |
| † Lire 280 | ROME : Fratelli Treves, Corso Umberto 1, 174 |
| | ROME : Fratelli Bocca |
| | TURIN : Rosenberg and Sellier, v. Maria |
| | Vittoria 18, and their Branches at Naples |
| | and Rome |
| JAPAN .. .. | Maruzen Co. All Branches |
| * £3 7s. 6d. | |
| † £3 3s. 0d. | |
| JAMAICA .. .. | KINGSTON : Educational Supply Co. |
| * £3 7s. 6d. | |
| † £3 3s. 0d. | |
| NEW ZEALAND | AUCKLAND : Whitcombe and Tombs, Ltd. |
| * £3 7s. 6d. | Gordon and Gotch, Ltd. All Branches |
| † £3 3s. 0d. | NAPIER : J. Wilson Craig and Co. |
| RUSSIA .. .. | LENINGRAD : Mezhdunarodnaya Kniga, Pros- |
| * £3 7s. 6d. | pect Volodarsky, 53 A |
| † £3 3s. 0d. | MOSCOW : "Litisdat," Kousnetsky Most, 5-15 |
| STRAITS SETTLEMENTS | SINGAPORE : Kelly and Walsh, |
| * $29·25 | Ltd. |
| † $27·25 | |
| SWEDEN .. .. | STOCKHOLM : A/B Wennergrens Journal- |
| * Kr. 61·00 | expedition, Stockholm 1 |
| † Kr. 57·00 | STOCKHOLM : A/B C. E. Fritzes Kungl., |
| | Hofbokhandel, Fredsgatan, 2 |
| SWITZERLAND | BERNE : Joh. William De Groot, Laupenstr. 5 |
| * Fr. 85·20 | ZURICH : Rosa Leibowicz, 4, Ankerstr. |
| † Fr. 79·50 | |
| UNITED STATES | International News Co., 131, Varick-street, |
| OF AMERICA | New York, N.Y., and all Branches |
| * $16·40 | Entered as second-class matter at the Post Office, |
| † $15·25 | New York, N.Y., December 12th, 1896, under the |
| | Act of March 3rd, 1879 (Section 397, P.L. & R.) |

* *Thick Paper.* † *Thin Paper.*

*These rates are liable to alteration if exchange fluctuations require it.*

*** READING CASES, *to hold two copies of* THE ENGINEER, *cloth sides and leather backs, can now be supplied at 4s. 9d. each, 5s. 3d. post free.*

### "THE METALLURGIST."

This Supplement, which deals with the Science and Practice of Metallurgy, both ferrous and non-ferrous, is published free with the last issue of THE ENGINEER in each calendar month.

### ADVERTISEMENTS.

**The charge for Classified Advertisements is 1/- per line up to one inch—minimum charge 4/-; those occupying one inch or more at the rate of 12/- per inch. Orders must be accompanied by a remittance. The rates for Displayed Advertisements will be forwarded on application. Classified Advertisements cannot be inserted unless delivered before TWO o'clock on Thursday afternoon (the day before publication).**

*Letters relating to the Advertisement and the Publishing Department of the Paper are to be addressed to the Publisher, all other letters are to be addressed to the Editor of* THE ENGINEER.

### THE ENGINEER DIRECTORY.

This Directory, which is published annually in the interests of advertisers in THE ENGINEER, may be obtained free of charge on application to the Publisher.

**Postal Address, 28, Essex-street, Strand, London, W.C. 2.**
**Teleg. Address, "Engineer Newspaper, Estrand, London."**
**Tel.: Central 6565 (8 Lines).**

*By arrangement with Reuter's Engineering Service,* **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers.*


## Contents.


THE ENGINEER, September 26th, 1930. PAGE

A SEVEN-DAY JOURNAL .. 329
THE SHISHKOFF HYDRO THERMAL TIDAL POWER SYSTEM.—No. I. (Illus.) .. 330
THE BRITISH ASSOCIATION.—No. III. .. 333
THE WIRELESS EXHIBITION. (Illus.) .. 334
INSTITUTE OF METALS.—No. III. .. 335
INTERNATIONAL AGRICULTURAL TRACTOR TRIALS. No. II. (Illus.) 337
THE USE OF HIGH PRESSURES AND TEMPERATURES IN THE GENERATION OF POWER. (Illus.) .. 340
RAILWAY AND ROAD MATTERS .. 341
NOTES AND MEMORANDA .. 341
MISCELLANEA .. 341
LEADING ARTICLES—
The Sampling of Coal .. 343
Small Works and Large .. 344
BOOKS RECEIVED .. 344
IRON AND STEEL INSTITUTE.—No. II. .. 344
THE BUILDING TRADE EXHIBITION.—No. I. (Illus.) .. 347
LETTERS TO THE EDITOR—
Foreign Tongues .. 348
Leisure .. 348
Concrete Roads and their Joints. (Illus.) .. 349
Cost of Helium .. 349
THE DETROIT RIVER TUNNEL .. 349
RIVER GUNBOATS FOR THE COLOMBIAN GOVERNMENT. (Illus.) .. 350
A NEW DIONIC WATER TESTER. (Illus.) .. 350
SIXTY YEARS AGO .. 350
NEW CUNARD SHIPS .. 350
B.E.S.A. SPECIFICATIONS .. 350
PROVINCIAL LETTERS—
The Midlands and Staffordshire .. 351
Lancashire .. 351
Sheffield .. 352
North of England .. 352
Scotland .. 353
Wales and Adjoining Counties .. 353
PERSONAL AND BUSINESS ANNOUNCEMENTS .. 353
SOUTH AFRICAN ENGINEERING NOTES .. 353
CURRENT PRICES FOR METALS AND FUELS .. 354
FRENCH ENGINEERING NOTES .. 355
BRITISH PATENT SPECIFICATIONS. (Illus.) .. 355
FORTHCOMING ENGAGEMENTS .. 356

SIXTEEN-PAGE SUPPLEMENT—"THE METALLURGIST."


### NOTICES TO READERS.

*** *If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

*** *All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.*

### The Metallurgist.

THE SEPTEMBER NUMBER OF THE MONTHLY METALLURGICAL SUPPLEMENT TO "THE ENGINEER" ACCOMPANIES THIS ISSUE.


# THE ENGINEER.

VOL. CL No. 3898

*SEPTEMBER* 26, 1930.


### The Sampling of Coal.

WITHOUT some guarantee as to quality, any reasonably black carbonaceous material found in the earth can be sold as coal. The purchaser can protect himself to a limited extent by stipulating for the product of a certain coalfield or a particular mine, but in doing so he restricts his sources of supply without getting in return the assurance that he needs. He can hope for greater protection and less restraint by specifying the limits of calorific value, ash and moisture, &c., which will be acceptable, but once he does this he raises the problems of sampling and analysis. With regard to analysis, there is no great difficulty. Competent chemists with suitable apparatus will generally agree within a very small margin on both the proximate and the ultimate analyses of any given sample of coal. But let them work on different samples taken from the same bulk, and the results may be quite discordant. Time after time, the purchase of coal by specification has been advocated, along with penalties or bonuses applicable to unavoidable variations in quality. Theoretically, nothing could be fairer, but before any such system can be generally accepted, the question of sampling has to be settled. The practice in power stations of taking periodical samples, automatically or otherwise, of the coal as it passes on its way to the bunkers, the samples being afterwards mixed and quartered down to get the final laboratory sample, does not meet the general case. The real problem is to get a sufficiently representative sample of the coal in bulk, as it lies in railway wagons, canal barges, or heaped on the storage ground. Mr. Selvey, we believe, once put the matter very aptly by saying that there was no scientific method of sampling coal which was practical, and no practical method which was scientific. This view does indeed represent the present situation. The aphorism does not help to solve the problem, though it does suggest that practical men will have to decide on some method of sampling coal in bulk which will satisfy ordinary commercial needs of accuracy. It is really time that something was done in a matter in which such enormous interests are concerned. The Fuel Research Board, to which one would naturally look for guidance, appointed a committee as long ago as 1921 to advise upon the sampling and analysis of coal. In 1925 the Board reported that the question of sampling was still under consideration, and to expedite matters it appointed a sub-committee with highly scientific qualifications to enable it to "formulate and publish recommendations in regard to this difficult and urgent question of the sampling of coal." The sub-committee apparently found the task beyond its powers, so the Fuel Research Board turned the matter over to the Engineering Standards Committee, which is still engaged upon it, nine years after the Board undertook to deal with it and five years after it admitted its knowledge of its urgency.

Difficult as the problem is, it must be solved. One would have thought that its solution would have been regarded as a necessary preliminary to the laborious "Physical and Chemical Survey of the National Coal Resources," which is absorbing much of the energy of the Fuel Research Board. For what is the value of elaborate analyses of samples of coal from different seams unless we know that the samples investigated really represent the bulk. There are already whole books full of analyses of British coals made by competent chemists in the service of power companies or large coal dealers, so that if any further information is to be of any use it must be based on samples undoubtedly representative of the typical products of the respective seams. Without assurance on this point, the work is waste of time. The Fuel Research Board must therefore have had to face the question of sampling at the commencement of its labours, and it would be interesting to know the procedure considered adequate for ensuring reliable results. There is only one test of the goodness of a sample, and that is its consistency with other samples. If two samples are found to be similar, there is a very strong presumption that both are representative of the bulk, while agreement between a greater number of samples turns the presumption into practical certainty. This elementary fact suggests a possible solution to the question of commercial sampling. In practice, of course, no two random samples are ever in exact agreement with each other. But one thing is certain, namely, that the average of the analyses of two such samples is likely to agree more nearly with the average of another pair than the individual analyses will agree amongst themselves. Hence, by averaging the analyses of a number of random samples, an analysis is obtained which must represent the bulk more and more nearly as the number of samples is increased. Not only do accidental differences become smoothed out by averaging, but the effects of laboratory errors are also minimised. The only question that arises is how many random samples are necessary in order that their average analysis shall represent the bulk with commercial accuracy. This is purely a matter for experimental determination. The procedure is simple. Take calorific value for example. First, it has to be decided what is meant by commercial accuracy in respect of this characteristic. Most engineers would agree that a figure which could be relied on as being not more than, say, 1 per cent. from the true, but only inferentially discoverable calorific value of the bulk, would be acceptable as commercially accurate. This means that for ordinary power station coals the true value must be known with a margin of error not exceeding 100 B.Th.U. per lb. Following our previous line of reasoning, let a random sample be tested for calorific value. Then let a second random sample be tested, and the average value of the two samples be written under the value first obtained. Let a third sample be then tested and the average of the three put down in the same column. Continuing the process, we know that every fresh average obtained is likely to be nearer the true value than the figure preceding it. We also shall find that the difference between the successive averages tends to become smaller and smaller. Hence, as soon as the difference becomes less than 100 B.Th.U., or any other value decided on, it may be said that the true calorific value of the bulk has been established within known and commercial limits of accuracy. In a similar way, and from the same samples, the

percentages of ash, moisture, &c., in the bulk can be determined within known limits.

The logic of the method is sound. It is mathematically certain that the true value is being continually approached, for the greater the number of samples the greater the proportion of the whole bulk that has been tested. Furthermore, as we have already pointed out, personal and instrumental errors become continually of less significance as they tend to cancel out. Hence the only important question is whether substantial consistency can be arrived at with a reasonably small number of samples. The answer can only be found by experiment. If it should be in the affirmative, and we think it would be so, some authoritative body could lay down a rule as to the number of random samples to be taken for every 100 tons of bulk, the number varying with the degree of accuracy required. We should then have a standard and practical way of arriving at figures on which contracts for the supply of coal could be based, and computations of boiler efficiency carried out. There should, moreover, be no insuperable difficulty as regards getting "random" samples. The human element certainly enters into the question, but so it does in any method of sampling. Present results depend very largely on the competence and good faith of both samplers and laboratory workers. A change of method would leave these factors as before, but with the advantage of minimising accidental errors. It would be a real service to all coal users if some central station or other engineer having the necessary facilities, would make an investigation on the lines indicated with a view to finding out the minimum number of samples required to give reasonable consistency. Whatever the figures might show, they would certainly give us much more information as to the probability of a sample of coal being representative of the bulk than we have at present. At the best they might indicate a practical solution to the problem of determining the characteristics of coal in bulk within known limits of accuracy.

### Small Works and Large.

AN American engineer has recently defined the difference between large and small engineering works as those that employ more than a thousand, or less than a thousand, hands. The lower margin is high even for America, and in this country we should class a factory with a thousand workpeople as large. But even if we place the upper limit for a small works at no more than three hundred men, it would be found that such businesses far outnumber those of larger size. Hence the small engineering works, though it receives far less public attention than the large one, which often figures upon the Stock Exchange, and, in these days, too frequently in Stubbs' lists, is an economic asset of great importance to the nation. It does its work quietly and unostentatiously; often it does not advertise; its name is not known outside the district in which it is situated and it has its own limited *clientèle* and its own markets. It is a great mistake to think lightly of these little factories, just because their equipment will not bear comparison with those of their bigger brothers, because they are conducted without the assistance of the latest office systems, because the principles of modern works management are sometimes unknown in them, and because the owners are never likely to adorn the House of Lords. They fill their own place, and fill it well, in the industries of the country, and we have heard it said that, taken for all in all, they earn larger dividends than works conducted on the best modern lines, provided with the finest equipment, and managed by boards of high eminence. The fact that great factories are essential to the industrial and economic welfare must not lead us to think that small factories are of little consequence.

There are several important differences, beside mere size, between the large factory and the small. One of them was brought home to us during a recent visit of the Newcomen Society to a works employing some thirty or forty persons, in which clockwork of various kinds is made. We were shown part of a mechanism and were told that it cost about £2 14s. to produce, whereas the complete unit could be purchased from a Swiss mass-production factory for 12s. 6d. But—and this is the point—the mechanism was required to differ slightly from the standardised foreign product, and the Swiss makers could not make that modification without upsetting their shop-routine. The small works could do anything required and in however small a quantity; the large works could only do what it was accustomed to do and would not look at an order for less than a thousand parts. That is a very typical example. Small concerns are never tied down by the standardisation which prevails to some extent in most large factories. They are satisfied with small orders, and, owing to low overhead charges, can make a good profit on them. The great works, with great oncosts, require large orders and in many cases must standardise the methods of production if not the actual details of design. Again, the management is almost impersonal and must act with the regularity of a machine. In the small factory, on the contrary, the management is wholly personal. Its success depends upon the ability of its manager, generally the principal owner, not only to make and sell products, but to buy materials. This direct touch leads to economies which the large concern has to seek in other ways. For one thing, less time is lost in office routine. "As soon as an organisation grows in size, it begins to consume time in its functioning. This time-consuming prosperity is the greatest objection to increasing the size of a plant," said Mr. A. B. Reynders, works manager of the American Westinghouse Company, in a paper presented to the American Society of Mechanical Engineers last June. All who have seen industries grow from small to large will appreciate his point. They see the office staff growing daily larger and larger without a proportionate increase in output. If we could take the "heat-balance" of any modern large offices, we should find the efficiency deplorably low. The larger the works, the more the organisation required and the greater becomes the number of employees engaged in handling the office system. All this routine wastes time, and the little man has completed the job before the big man has made all his arrangements for beginning it. To overcome this difficulty and to secure, moreover, some of the other well-known advantages of the small shop, the American Westinghouse Company has organised a special department on "small factory" lines. Orders of ten units or less, whether standard or special, can be produced in this department, the shops of which are fitted with general purpose tools. That is an ingenious scheme, and if the problem of allocating overhead charges can be solved, it should prove extremely interesting and instructive. But just as in the real small works success depends upon the individual ability of the proprietor, so it must in this pseudo-small works. It will fail to simulate the real thing if the full-dress management of the main works attempts to control it.

It is often said of the British manufacturer that he will not give the purchaser what he wants. The fact that exactly the same charge is brought against the manufacturers of other nations by their own critics, ought to warn us that the cause is fundamental, not capricious. The manufacturer on the large scale cannot change the design to suit every purchaser. Indeed, he resists any change at all, for it may involve the dismantling of valuable equipment. If he introduces a new pattern or a new design before there is a real call for it, even though it be good, he must go to a great deal of expense in developing a demand. All that means money expended—some on plant and some on salesmanship. He may have, moreover, large stocks of partly made or completed parts on his hands. The small man is worried by none of these things. He will change the design as often as you like, and is as ready to make one unit as a score. He cannot, of course, compete in price with mass production, but, as his oncosts are low, his price is not so high as those asked by his big competitors for similar quantities. The small works has several other peculiar merits familiar to all who do not condemn without thought everything that appears to be inefficient, and neither in this nor any other industrial country are we likely to see the day when vast factories will outnumber humbler, but essentially useful factories with no more than from ten to two or three hundred hands.

## BOOKS RECEIVED.

*Der Graphit.* By O. Kausch. Halle (Saale): Wilhelm Knapp. Price 25 marks net.

*Modern Sewage Disposal and Hygienics.* By S. H. Adams. London: E. and F. N. Spon, Ltd., 57, Haymarket, S.W. 1. Price 25s. net.

*The Principles of Structural Mechanics.* Second edition. By P. J. Waldram. London: B. T. Batsford, Ltd., 94, High Holborn, W.C. 1. Price 12s. 6d. net.

*The Significance of Spores in the Correlation of Coal Seams. Part I.: The Parkgate Seam—South Yorkshire Area.* London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 1s. 3d. net.

# The Iron and Steel Institute.

### AUTUMN MEETING IN PRAGUE.

No. II.*

THE next paper to be discussed was entitled "What Reasons Compelled the Prague Ironworks to Introduce Thin-walled Blast-furnaces?" by Ing. Dr. J. Sarek, of which an abstract follows.

### THIN-WALLED BLAST FURNACES.

The data existing in the literature on thin-walled blast-furnaces installed at Ria in Spain and on Burgers type furnaces used in Germany, do not give an altogether favourable picture of the results obtained in their operation, indicating but few of their advantages. In spite of that, thin-walled furnaces have recently been introduced in America, while in Europe, owing to the opinion still extant that such furnaces require a high consumption of coke, they have not become very popular. It is therefore worthy of note that four years ago the Prague Ironworks Company decided to install thin-walled furnaces, and now that the fifth furnace of that type is being built, it may be said that the considerations forming the basis for that decision have been fully confirmed by the experiences gained with these furnaces during the last four years.

The successful results obtained may be explained by the fact that with the type of charge commonly used at the company's plants, which is quite different from the normal charges usually met with at other works, thin-walled furnaces offer a ready means of control that was not available with the thick-walled blast-furnaces formerly used. This kind of charge, depending upon the properties and availability of the ores at the company's disposal, causes serious difficulties during smelting which account for many of the troubles and interruptions in operation experienced prior to the introduction of thin-walled furnaces.

The troubles and failures in operation, however, drove home the necessity for seeking their causes and thus instigated careful studies of the blast-furnace process. These efforts resulted in the discovery of the causes of the troubles, which were eliminated as far as possible. Thus, the difficulties encountered in treating the ores occurring in Czechoslovakia were materially reduced, and in this the introduction of the thin-walled blast-furnace played an important part.

After discussing the theory of blast-furnace working, the author continues as follows:

Observations made at Kladno and at Králuv Dvur, that the furnace lining only a few centimetres thick, which was the case at the places where it was melted off, would last well for a comparatively long time, led to the consideration of means of utilising this fact. Since the thick lining melted off at the inner surface because it was not sufficiently cooled, whereas the thin lining cooled by air proved to be successful, it was easy to conceive the idea of building thin-walled furnaces. The chief argument against this idea, which was supported by the literature on Burgers furnaces, was the fear of an increased fuel consumption. Since, however, furnaces with melted-off linings and irregular deposits on the walls, being uncontrollable, worked on a higher coke consumption than sound furnaces maintaining their original lines, which could not last long, and since besides there were many failures in operation, it was expected that the introduction of thin-walled furnaces might lead even to some lowering of the coke consumption in comparison with that in furnaces of the old type, and certainly would result in a decrease of failures in operation. The first was installed four years ago at Kladno, and now the Prague Ironworks Company is already building its fifth furnace of this type. Experience gained during these four years has fully justified the expectations. The furnaces preserve practically constantly their original lines, the lining does not melt away for long periods of time, troubles in operation are decreased, and the consumption of coke is not increased, but is even lowered.

In opening the discussion on that paper, Mr. A. Hutchinson said it would greatly stimulate interest in certain aspects of blast-furnace practice respecting which it was exceedingly necessary to have more details.

Mr. Simons said that he was immediately attracted when he saw the paper, for in its work in South Wales his company had had considerable difficulty with the general method of building blast-furnaces in Great Britain and America, the general practice in those two countries being to use a strong steel lining. Generally, the continental practice had been to employ a structure outside with more or less thin lining. It was rather interesting to hear now that America had put in designs of blast-furnaces similar to that given by the author in the paper. It had been still more interesting to him when in Germany last year to find that German ironmasters had adopted the British practice and were using the steel-lined casing.

His difficulty had been that above the lintel in the blast-furnace the lining was very thick in all cases. He and others had spent a great deal of money in building the hearth and the bosh; they put in carefully dressed bricks and very costly bronze coolers. From the bottom up to the lintel was the most expensive part of the blast-furnace. His experience was that in the portion of the blast-furnace above the lintel where it was frequently 4ft. thick and seldom less than 3ft. thick, the lining wore away, with the result that irregular working of the furnace and increased coke consumption resulted, as the author had said. They had thought to overcome that difficulty by putting in vertical coolers. They had put in a ring or a large number of vertical coolers, about 6ft. deep, water-cooled, about 9in. from the face of the brick. But as soon as that 9in. got worn back the cooling was too intense, and the cooling was too rapid, hence the material was in a pasty condition and irregular working and irregular quality resulted. So that that plan was a failure. There was no doubt that the author was perfectly right in claiming that the safer method was to have a thin lining. In order to overcome the difficulty he (the author) was putting in an inner steel casing following the line of the furnace, and cutting out the outer casing so that the inner casing could be got at and water-cooled if necessary. He was able by that means to keep the thin lining and to keep the

* No. I. appeared September 19th.

shape of the furnace as recommended by the author as being essential for good working of the blast-furnace.

He wished the author had given them the tonnage that had been produced. That would have been very interesting, because, to his mind, the lining ought to last up to about 750,000 tons in order to give what he called satisfactory results. He did not know to what extent the author's furnace had given satisfactory results in that direction. That was an essential, because, in the present-day blast-furnaces, which produced anything from 2500 to 3000 tons a week, the cost of lining was not less than £10,000. The regular working and long life of the lining was a matter really requiring most careful consideration.

Professor R. Vondracek (Brno, Czechoslovakia) said that the paper dealt mainly with difficulties arising from the improper penetration of the charge column by the blast. That irregularity and its reactions were, of course, the subject of repeated study, and had been particularly analysed by J. E. Johnson, who said, in his fundamental work, "The Principles, Operation and Products of the Blast-furnace": "If the gas is passing too much to the centre and a scaffold begins to build on the walls just above the tuyeres, its tendency is to throw the gas still more strongly to the centre and thereby favour still further building on the walls, this condition continuing until the furnace can no longer operate." On the other hand, there was the case of a furnace with very deficient penetration in which the charge column built up like a cone in the centre of the hearth and filled the latter up until there was nothing left except a narrow ring around the outside. In that case the formation of a "dead man" in the centre of the furnace naturally tended to throw the blast back more strongly against the walls and so cut them away more actively, with the result that the lining of the hearth on this furnace was almost totally destroyed.

Dr. Sarek followed the influence different burdens might have on the running of the blast-furnace and pointed out the favourable effect of the more external running in the case of certain ores, and particularly demonstrated the effects of the internal and external runnings on furnaces with lines designed for hot grades of pig iron, if they had to be used for melting colder grades of pig. It was, indeed, an interesting fact that thin-walled blast-furnaces proved suitable, and that the coke consumption in them was even lower than in furnaces of the older type. He thought it would be interesting to know what the reason of the reduced fuel consumption might be. If Dr. Sarek could give any data on the actual and former coke consumption they would be welcomed.

Mr. David E. Roberts (Cardiff) said that the question of how best to treat that part of the lining immediately above the lintel in a blast-furnace was one which had been engaging the attention of constructional engineers and blast-furnace people for many years. He had in his possession a drawing, which he had got in America, he supposed about 20 years ago, of a furnace built with thin lines at that portion of the stack. The ordinary hearth and bosh were like nearly every furnace in America, built in with copper blocks and that sort of thing, but above the bosh a kind of false lintel placed some 10ft. or 12ft. above the ordinary position had been made, and that length of lining from above the usual lintel level up to the new one was of quite thin material and was banded and sheeted in the usual way. What success that met with he never knew, but he presumed it could not have been altogether successful, because it had not been continued in regular use over there. He was inclined to agree with Mr. Simons, that for that portion of the furnace the thin lining had a good deal to be said for it.

The third paper taken at the first session was one by Dr. W. H. Hatfield on "Permanence of Dimensions under Stress at Elevated Temperatures," of which an abridgment will be given later.

In opening the discussion, Mr. F. W. Harbord, Past-president, said one of the engineer's most important duties was to say what the limit of safety was. He was not able to do so. Dr. Hatfield had, in his paper, given a reasonable approximation to what was a reasonable limit. The curve printed in the paper was something to start with, and later on more data would be available to build up on.

Dr. A. McCance said he did not think Dr. Hatfield had distinguished between total deformation and rate of deformation. The very basis of his test was the examination of material with a very slow rate of deformation. The method he described proved that it was the rate, and not the actual deformation. The question of a quick test was of great interest, as ordinary tests took a great deal of time. Mr. W. Bailey had now postulated that a rate of deformation of one thousand millionths of an inch was necessary to secure an accurate conception of creep. The extraordinary divergencies of the results in the table accompanying the paper were not to have been expected, and might lead to the diminishing of the number of steels hitherto proposed for high temperature resistance. He (Dr. McCance) rather hoped that would result. There were so many of them that users did not know what were the best to use for their specific purposes.

Dr. Hatfield, in reply, said the curve put forward was tentative. He would not disagree with Dr. McCance. Both he and Dr. McCance were perfectly right. There was a fresh set of data constantly accumulating, and with methods less exact than those now available the results used to be higher than they now were. At the same time the accumulation of fresh data could not be postponed pending the refinements necessary to secure highly accurate results. Those described in the paper were sensitive to $^1/_{3000}$ millionth of an inch, and the results took over a year to obtain. It was a question of choosing between the time factor and the sensibility of measurement. Dr. McCance had truly suggested that not all the steels put forward as heat-resisting possessed all the advantages claimed for them. It was possible to have 30 to 40 per cent. of chromium present, without increasing the heat-resistant strength, or to put in a lot of nickel, and not do so. Together they increased the strength a little, but did not give the requisite strength at high temperatures. If, however, tungsten were added a steel was obtained that did possess that strength. A steel containing chromium, nickel, and tungsten came out very well and gave a reliable high-temperature resistant steel.

---

## VISITS.

### The Trinec Works of the Czechoslovak Mining and Ironworks Company.

A visit to the Trinec Works of the Czechoslovak Mining and Ironworks Company took place on the morning of Thursday, September 18th. The company, of which Mr. Eugène Schneider is chairman, is carrying on traditions relating to coal mining and the manufacture of iron which date back many years, and in 1906 was acquired from the Archduke Frederick of Hapsburg, by the Bodenkreditanstalt of Vienna. The works at Trinec, which are close to the Polish frontier, are exceedingly compact and comprise blast-furnaces, steel works, rolling mills, foundries, and a very fine coke oven plant, besides a number of subsidiary departments, including railway and other material shops, a refractory department, and an interesting copper recovery plant dealing with pyrites from which the copper is leached out and subsequently precipitated on iron scrap, of which further mention will be made.

The visitors were taken in groups round the works, visiting the various departments in sequence; but for the purposes of description it is better to take them in what may be regarded as the natural order. Incidentally, it may be said that such a sequence would involve delivering raw materials on the top of a stupendously high building and delivering them by gravity, stage by stage downwards, the ores to be graded and the coal to be coked "on the next floor below." Thus prepared, the blast-furnaces would be placed immediately below and just over the steel furnaces, into which they would deliver hot metal, while finally the ingots would pass "by gravity" through soaking pits into vertically disposed rolling mills on the ground floor, whence railway trucks would take them away. This ideal arrangement may yet be possible, and although vertical combination has proved in the past sometimes top heavy, it may work all right. In the meanwhile the Trinec Works as at present laid out and organised may be said to realise this ideal rather closely, for if the blast-furnaces are not directly over the steel works, they are as near to it as in the interests of time, fuel economy and efficiency generally it is possible to get them.

The Trinec Works derive their ores from iron mines belonging to the company at Marianska Hur and Bindt, where spathic iron with about 33 to 36 per cent. of iron and a little over 2 per cent. of manganese, which calcines to 48 per cent. Fe and 2·6 per cent. Mn, from Swedish mines in which the company formerly held interests and still has a close connection, and from Austria, Russia, Norway, Greece and Spain, and even from Morocco. It has a manganese ore mine at Svabovce, and limestone quarries at Varin and Vrutky. The company also owns extensive collieries raising 4,000,000 tons of coal per annum, and reserves which are described as inexhaustible. The average composition of the coal used at Trinec has 4 to 18 per cent. of ash and 0 to 1 per cent. of sulphur. It cokes well and makes a dense and thoroughly satisfactory blast-furnace fuel.

The raw materials are delivered on a high-level track by rail, and each wagon to be unloaded passes on to a turntable, upon which it can be locked. The turntable is then turned through an angle of 90 deg. and the ore taken to bins, whence it is removed for crushing and screening, all ores being graded by size and all fines agglomerated or nodulised in a splendidly equipped calcining plant in which the larger ore is likewise roasted. The ore bins have a capacity of 330,000 tons, or sufficient for six months' reserve. The calciners operate on the Schmidt system. Two are 30 m. long and 2 m. in diameter, while the two newest are 47 m. long and 2·4 m. in diameter and have a capacity of 230 tons of nodulised ore per twenty-four hours. The final product contains about 62 per cent. Fe, 1·2 per cent. Mn, 0·02 per cent. S, and 0·04 per cent. phosphorus. The coking plant consists of a Rhéo washery—output 165 tons per hour—a crushing plant and a battery of thirty-five Otto-Hoffmann ovens, two batteries of sixty and thirty Koppers regenerative ovens, and a further battery of twenty-eight Koppers ovens, all heated by blast-furnace or coke oven gases or mixtures of the two. The chambers of the largest and latest ovens are 12 m. by 4·2 m. by 0·35 m., and as the coking period is only twelve hours the daily output of this battery is 525 tons of coke per twenty-four hours, while that of the whole plant is about 1500 tons.

There are four blast-furnaces, two with a daily output capacity of 320 tons each, one of 360 tons, and one of 650 tons. The latter is 30·5 m. in height and is bucket charged on the Stähler system. The stoves are on the Cowper system in four groups of four each. The effective volume of the largest blast-furnace is 473 cubic metres. It takes blast at 17 lb. per square inch from "Skoda" gas-driven Nurnberg engines, of which there are five with a capacity of 850 cubic metres of air per minute, and one with a capacity of 1220 cubic metres per minute. As reserve there have been installed two steam blowers of 620 cubic metres capacity each, and a 450 turbo compressor. For cleaning the gases both the Zschokke and the Dingler-Stolte systems are used; cleaning is taken to 0·02 to 0·03 gramme per cubic metre. A gasholder of 30,000 cubic metres capacity serves to regulate the pressure.

Steel plant No. 1 at Trinec has six 35-ton basic open-hearth steel furnaces and an 80-ton Wellman-Seaver tilting furnace, besides a blast-furnace-gas fired mixer of 300 tons capacity. In steel plant No. 2 there are three 35-ton open-hearth furnaces, two 32-ton furnaces, and a Bosshardt 5-ton furnace. The pig iron ratio in the charge is 75 per cent. There are extensive and well-equipped steel foundries capable of making castings up to 18 tons, and with an annual output of about 3000 tons and an ironfoundry with four cupolas and three air furnaces. The large iron castings section has an annual capacity of 12,000 tons, while the small castings section has a capacity of 6000 tons annually.

The rolling mills consist of a cogging mill, which was the first mill ever installed with electric drive, and is on the Ilgner system, and a similarly driven reversing mill with a roughing stand and three finishing stands. The output of the blooming mill is 500 to 600 tons per eight-hour shift, and that of the reversing mill 450 tons per shift. There are also a three-high mill, a "medium" mill, and three merchant mills, besides a new continuous rolling mill for billets and sheet iron bars.

In the very interesting account of the Trinec Works, written by Professor Stoces and presented by the company to the visitors, this mill is described as unique in Europe as to its construction. It is constructed on the same principle as the American Morgan continuous rolling mills, but had to be adapted to local requirements, because in Europe the rolling mills of this kind have to roll many different shapes of merchant iron each in small quantities. There are two groups of stands situated one behind another. The rolls of the first group have three grooves each, the two extreme grooves being intended for rolling billets of a size varying between 108 mm. by 108 mm. by 80 mm. by 80 mm., while the central groove is to rough the sheet bar for the second group of stands. The second group is separated from the first by a distance equal to the length of the rolled piece.

The special position of grooves in the rolls and of shears and skid ropes near the stands enable different kinds of semi-products from different parts of the bar or billet to be obtained. It is, for instance, possible to employ the faultless middle part of the bloom for manufacturing sheet iron bars of the best quality, whilst the cropped upper and bottom ends of the roughed ingot may be rolled into billets for ordinary merchant iron. The middle part of the bloom may also, if required, be rolled into billets of the best quality. The shearing appliances of the mill enable cropping off any part of the rolled bloom.

The first group with eight stands is driven by a 5500 H.P. motor; the four first stands of the second group are driven by another motor of the same capacity, whilst the fifth and sixth stands are provided with their own continuous current motor of 1500 H.P., in order to be able to change their speed over a considerable range in accordance with the exit velocity of the rolled piece from the first four rolling stands. The motors are connected together by means of regulating devices, which serve for automatic variation of speed in accordance with the power requirements of the first four stands driven by alternating-current motors. Continuous current for motors is supplied by a Leonard converter, consisting of two special dynamos of 1360 kW each and of an induction motor of 2900 kW. The soaking furnaces for heating ingots have a capacity of 1125 tons.

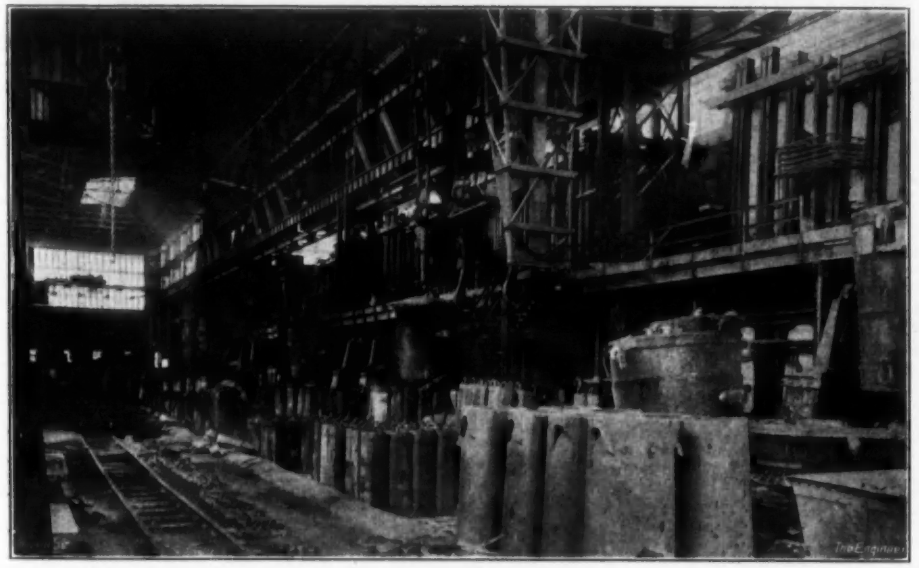
A set of vertical rolls, scrapers between the fifth and sixth stands of the second group, double polishing of the two last passes and finally water-cooled runaway secure an entirely smooth and faultless surface of the rolled pieces. The division of the hot bed into two branches permits, moreover, a sorting of the sheet iron bars into two qualities.

The output of the mill is 1000 tons per eight hours, when rolling roughed ingots of 4000 kilos. The mill rolls sheet iron bars of a width of 300 mm., 250 mm. and 200 mm. and from 6 mm. upwards thick; billets are rolled in sizes of 108 mm., 80 mm., 70 mm., 65 mm. and 50 mm.

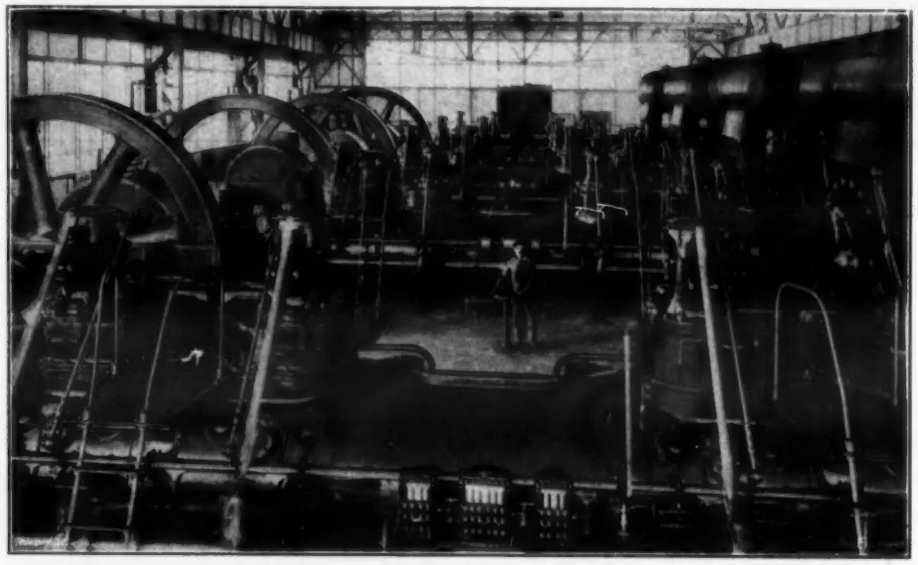
Other departments of the works, as well as the chemical and research laboratories and testing depart-

# THE TRINEC IRON AND STEEL WORKS, CZECHOSLOVAKIA

COKE OVENS



STEEL FOUNDRY



BLAST FURNACE BLOWING ENGINES

CONTINUOUS ROLLING MILL

ments, were freely shown to the visitors, who were also greatly interested in the gas control department. This is designed to apportion, in the light of research, the most suitable gas mixtures for the various purposes for which they are required.

Control of the mixtures is effected by applying a direct differential pressure to the mixing valve through the intermediary of a pressure plate that is built into the piping in front of the regulator throttle valve. The two pipe lines conducting the gas, the amount of which is to be controlled, have a mutual mixing valve. Each pipe line has, besides the regulator throttle valves, a pressure plate, the throttling ratio of which and the differential pressure caused thereby are proportional to a certain amount of gas. If, however, the amount of gas changes, the differential pressure at that particular pressure plate increases, thereby actuating the regulator and thus opening or closing the throttle valve until equal, or the desired differential, pressure is attained at the pressure plate, which means, in other words, that the ratio of the mixture of the two gases is automatically kept uniform. The mixture valve is further provided with a device making it possible to alter the effective ratio of the two differential pressures, thus enabling one to change over from the theoretical ratio of, for instance, 1 : 1 to 1 : 0·9 or 1 : 1·2 or any other ratio desired without interrupting operations in any way.

In the case of the Trinec plant, it is however, not so much a certain ratio of the two gases—blast-furnace gas and coke oven gas—to one another in respect of quantity, but rather in regard to uniform calorific value that is sought. The gas mixing plant is therefore equipped with three recording calorimeters of the Junkers type, one each for blast-furnace gas, coke oven gas and for the gas mixture. The man in charge of the gas mixing plant continually observes the calorific value of the gas mixture as recorded by the calorimeter and compares it with a table showing the values corresponding to the gas temperature recorded and to the average barometric pressure of 733·5 mm. Hg. column for a calorific value of 2400 kcal./m³., which is the minimum figure for the calorific value of the gas mixture—that is, normally between 2400 and 2600 kcal./cubic metres—according to the surplus amount of coke oven gas available. The ratio of blast-furnace gas to coke oven gas is then adjusted by operating the differential pressure throttle valve, thus controlling the ratio of the mixture. On page 346 we give four views taken in the works.

*(To be continued.)*

## The Building Exhibition.

No. I.

AT the present time, when building is being carried on at such an intensive rate, the Building Exhibition is of especial interest, and it is not surprising to find that it is the largest of the series which has been held. It was opened at Olympia on September 17th and closes on October 1st. Some idea of the extent of the show may be gathered from the fact that it occupies the whole of the main building in Kensington, with part of the new annexe, while there are at least 400 stands.

The exhibits are most various in their nature, as they cover the whole of the requirements of the builder of both domestic and industrial buildings. We will not, in this account, attempt to deal with the structural materials, such as bricks, tiles, concrete, and so forth, although their production involves the use of a considerable amount of mechanism; neither will we enlarge upon the very handsome displays of timber, except for one example, which, we believe, is attracting the attention of engineers' pattern makers. It is a "ply-wood" exhibited by James Latham, Ltd., of 124, Curtain-road, E.C. 2. This material is built up of two exterior layers, spaced apart by closely packed laminations set on edge—not flatwise, as in the usual three-ply. One can picture it as a great number of laths glued together on their sides—not edges—and then enclosed by a veneer on each side. The whole assembly is, of course, glued together under great pressure. By building up the board in this way it is possible to eliminate any local defects in the timber used and to make a very homogeneous mass, so that the board keeps its shape and does not warp. The arrangement, naturally, is best applied to boards of reasonable thickness.

There is one other matter in connection with timber that we would like to mention, and it developed in conversation with one of the timber merchants. It is the economy in cost which can be effected in using plywood for panelling and similar purposes, where it is desired to have a fancy wood on the outside. Take, for instance, walnut about ⅛in. thick. It is possible to save some 20s. per 100 square feet by using a three-ply, in which the centre layer is pine wood, over the cost of a solid walnut board. It is a good testimonial to the efficiency of modern woodworking machinery, for the process of making plywood involves several operations and expensive plant.

*Apropos* woodworking machinery, it is noteworthy at the Exhibition that there is a predominance of foreign-made machinery, and that a large proportion of these exhibits are staged by firms with English names. There are salesmen of English nationality, but the really technical details of construction must in many cases be obtained from the foreign representatives on the stands. However, the Exhibition is well representative of practice in the British building trade, and we give below some descriptions of exhibits likely to interest engineers.

### WINGET, LTD.

The name of the Winget Company of Warwick is generally associated with machines for making concrete blocks, and naturally there are some of this class shown on its stand; but there is also a variety of other machinery connected with the building trade, such as concrete mixers, stone and brick crushers, hoists and diaphragm pumps. Of these, we illustrate in Fig. 1 a new form of pump for lifting and

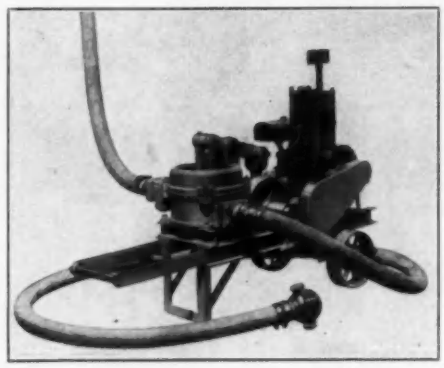


FIG. 1—PORTABLE PUMP—WINGET

forcing purposes. It is mounted on a frame with two wheels, so that it is reasonably portable, but yet, when set down, is sufficiently stable to run without scotching. The power unit is a Lister petrol engine of the hopper cooling type of 2 horse-power in the case of the 3in. pump and 3 horse-power for the 4in. pump. The pump itself has a reinforced rubber diaphragm beneath which there are the inlet and discharge valves of leather. The water consequently does not have to come into contact with any rubbing metal faces, and gritty water can be pumped with impunity. The diaphragm is operated by a rocking lever and pitman from a gear-driven countershaft, which is connected with the engine by means of a bush roller chain. The gear wheels are, by the way, machine cut. The machines are good substantial jobs, and should, we think, stand up to hard usage. The smaller size will handle 4000 gallons per hour, and the larger 5500 gallons when working on a 5ft. lift, and both will suck from a depth of 25ft. and raise water to a height of 60ft.

### PENFOLD FENCING, LTD.

The fencing wire on the stand of Penfold Fencing, Ltd., Balmoral-road, Watford, Herts., is interesting to engineers from two points of view. It is made by an ingenious process of pre-forming the wire, much after the fashion of making a wire mattress, which has already been described in our columns, and it is gaining rapidly in favour as a material for sectionalising workshops where it is desired to retain an unobstructed view. Unlike the familiar hexagon mesh chicken netting, the Penfold fencing is made with the wire strands running transversely and has an approximately square mesh. Each of the strands is virtually a flattened helix, into which another strand is interlaced. There is only half a turn at the junction of the two strands, and not several twists as in the case of chicken netting; as a consequence, the wires forming the sides of adjacent meshes lie almost in line diagonally across the netting, and the material keeps quite flat. It is stretched out by tightening two longitudinal wires at the top and bottom. We were told that only British wire is used in the manufacture of this netting, as the process is rather punishing to the galvanising, while the steel must stand up to the sharp bending at the corner of the mesh without any tendency to spring back out of shape.

### H. AND E. LINTOTT.

There is a rather fine pug mill for brickmaking works on the stand of H. and E. Lintott, of Horsham, Sussex, which we illustrate in Fig. 2. The machine looks rather formidable as it stands, but, as will be seen from the ground level mark on the illustration, a large part is sunk in a pit, so that the hopper and outlet to the table come to a convenient working level.

The machine comprises a pair of rolls through which the clay is fed from a hopper to crush any rough lumps. These rolls are mounted on bearings in slides and are held together by springs, so that they can yield in the event of any unusually hard substance being dropped into the hopper. The rolls are driven by substantial shrouded toothed gearing from fast and loose belt pulleys. The clay passing the rolls drops into a large rectangular box made of cast iron plates, which are bolted in place so that they are readily removable. In this box there is a horizontal shaft driven through speed reducing gearing, on which there is bolted a set of paddles or stirrers. Some of these paddles are knifelike, while others are set at an angle to the axle and act as propellers to move the clay forward towards the outlet. The shaft is square and the paddles are made in two halves, bolted together, so that it is a simple matter to replace a broken or worn arm.

The rotation of the paddles in the rectangular box naturally leaves a certain amount of dead clay in the corners, and this might appear at first sight to be a disadvantage; but it was pointed out to us that it had the merit of providing a space into which any stones or hard pieces that had passed the rolls could be pushed without damage to the paddles. It is a simple matter occasionally to remove one of the side plates and clear out the *débris*. The mixed clay is pushed out of the box into the boot of a screw elevator driven from the top end by gearing, and is delivered on to the brick making table. The machine is capable of pugging sufficient clay to make from 800 to 1200 bricks an hour and requires 10 horse-power.

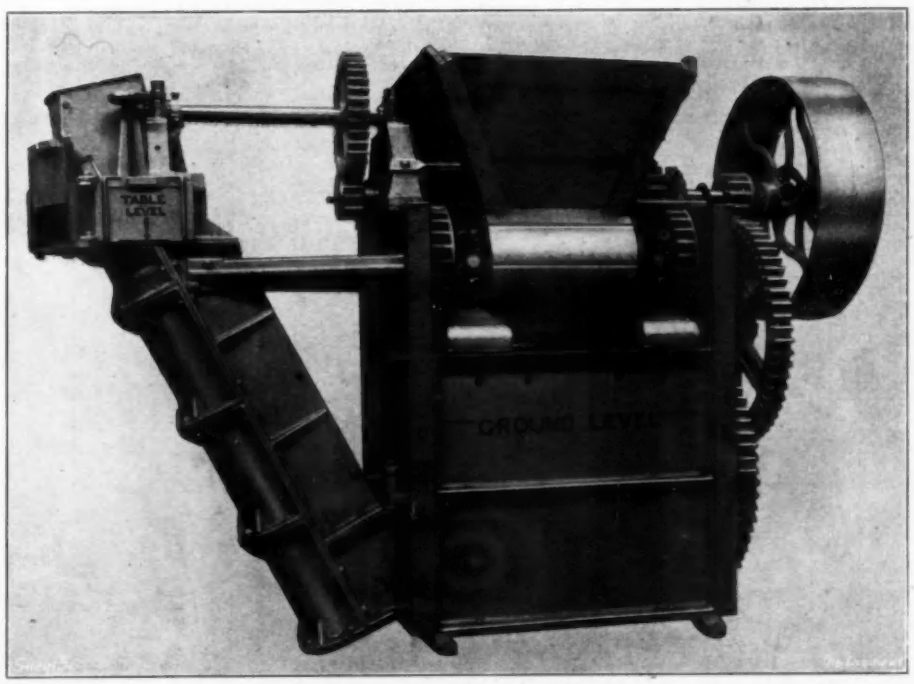



FIG. 2—PUG MILL FOR BRICKWORKS—LINTOTT

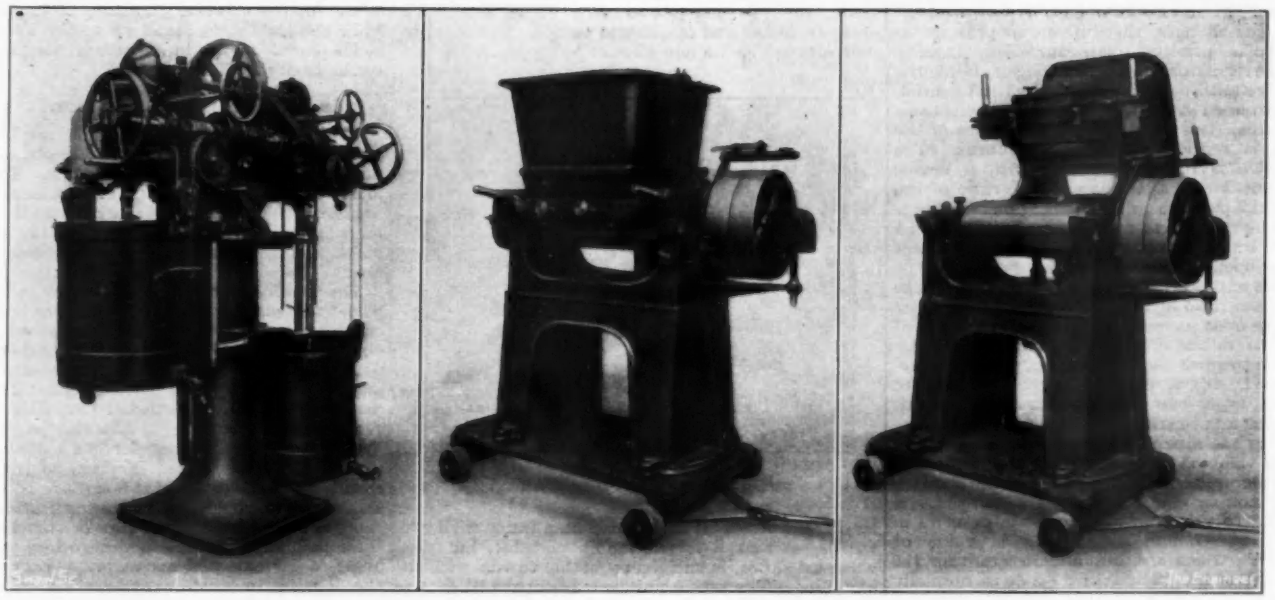
### THE GRINDING, MIXING AND SEPARATING COMPANY, LTD.

There is a display of paint making machinery on the stand of the Grinding, Mixing and Separating Company, Ltd., of 35, Garratt-lane, Wandsworth, London, S.W.18, and we illustrate two of the machines in Figs. 3, 4 and 5.

The paint mixing machine shown in Fig. 3 is chiefly noteworthy through having a power-driven

winding gear for lifting the paint cans into position. It is of the type in which a pair of vertical rotary paddles is used to stir the paint, and these paddles are driven by bevel gearing from an overhead shaft. The paddles are fixed at such a height above the floor that a full paint can can be wheeled beneath them and then hoisted up into the working position. Turned guides are provided to steady the can when it is raised. The winding gear consists of a small rope drum driven by worm gearing from an overhead shaft. This shaft, in turn, is driven through a dog clutch, by a chain from the main shafting. The hoisting rope runs through pulleys, which are clipped on to lugs on the sides of the paint cans. When it is desired to lower the can the hand wheel, which shows prominently in the illustration, is given a spin, and the weight of the can is then sufficient to overcome the resistance of the worm gearing. The equipment is, of course, duplicated on either side of the machine.

The single roll paint mill shown in Figs. 4 and 5 is intended for grinding paints with those evasive tints which do not readily mix with the base. As a consequence, the paint is passed through the mill several times in succession, and a mixing besides grinding action is obtained. The mill comprises a chilled cast iron roll with a highly polished surface above which there is mounted a hopper. The bottom of the hopper makes a good fit on the curvature of the roll. At the side of the hopper towards which the roll rotates there is fixed a longitudinal cast iron bar with a concave face to correspond with the curvature of the roll. The paint is dragged out of the hopper, under this bar, by the rotation of the roll, and in the passage is effectively ground. Micrometer adjustments are provided for setting the distance apart of the bar and the roll, and the roll is given an axial movement to prevent the wearing of grooves in either the bar or the roll. So far, the mill is orthodox, but instead of scraping the paint off the roll, by means of a stationary knife directly it has passed under the bar it is allowed to pass right round underneath the roll, clinging to its surface, and is scraped off by a knife within the hopper. The hopper is divided by a longitudinal partition and the paint scraped off is entrapped on one side until its level rises so far that it overflows over the top of a weir and then goes through the grinding process again. The result is a very thorough mixing of the ingredients and an absence of streakiness in the paint. As will be observed from the illustrations, the hopper is hinged, so that the machine can be easily cleaned, while fine-screw adjustments are provided for the grinding bar, doctor knife, and so forth.



FIGS. 3, 4 AND 5—PAINT MIXING AND GRINDING MACHINES—GRINDING COMPANY

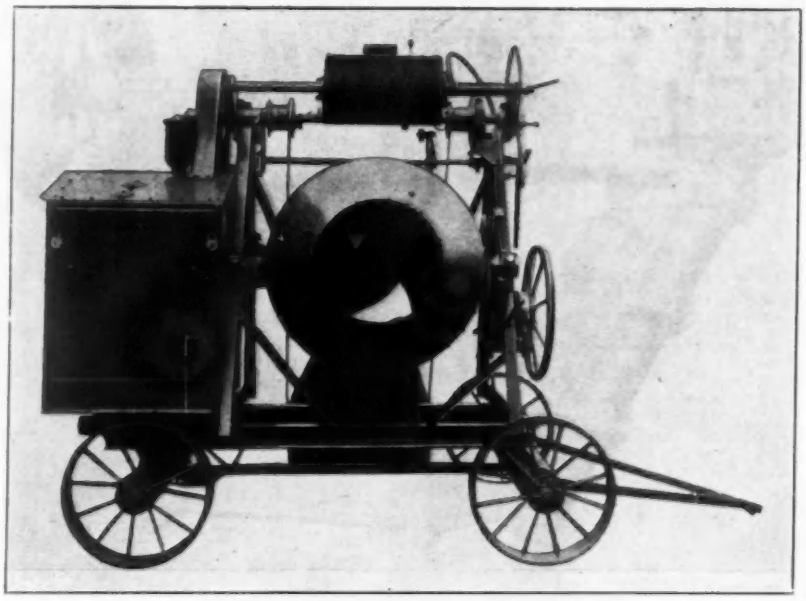


FIG.—6 CONCRETE MIXER—MILLARS' MACHINERY COMPANY

MILLARS' MACHINERY COMPANY, LTD.

A new form of concrete mixer shown by Millars' Machinery Company, Ltd., of Pinners' Hall, Great Winchester-street, London, E.C. 2, is illustrated in Fig. 6. It has a capacity of from 70 to 80 cubic yards of concrete per shift of eight hours, and takes 10½ cubic feet of concrete in the unmixed state in each batch.

As will be seen from the engraving, this mixer is of the normal revolving and tilting drum type, but the machine embodies several novel features. It is driven by a 4½ horse-power hopper-cooled petrol engine, which has a hinged crank case to facilitate access to the bearings, timing gear, &c. It is fitted with a high-tension magneto and, besides being totally enclosed within itself, is well protected by a weather-proof casing. The drives for both the drum and the loader are transmitted through Hans Renold steel-bushed roller chains.

The loader bucket, which is in the background in our illustration, is of the Jaeger type and is hoisted up into the discharging position by a pair of wire ropes, while it pivots about double hinged links that give a high tilting angle. The hoisting gear is driven through a clutch which is engaged by hand when it is desired to raise the loader. When the loader arrives at the top position it automatically knocks out the clutch and applies a brake. At the same time a horizontal shaft running beneath the hopper is connected with a jerking gear and two tappets shake the hopper to hasten the discharge of its contents—a much more satisfactory scheme than the common usage of beating the loader with a heavy hammer.

The water tank, which has a capacity of 9 gallons, is a drum mounted on a horizontal axis, and is emptied by tilting. It is fitted with a stop device, graduated in gallons, that determines the angle to which it is tilted, and, consequently, the amount of water discharged. The wheels are 24in. in diameter by 4½in. wide on the tread, and can, if desired, be fitted on stub axles that can be turned round, so that the discharge can be made over either the side or the end of the machine.

*(To be continued.)*

## Letters to the Editor.

*(We do not hold ourselves responsible for the opinions of our correspondents.)*

### FOREIGN TONGUES.

SIR,—Being interested in the international aspects of engineering and science, I noted with great interest the letter of Mr. Edward S. Hodgson in your August 15th number. It seems that he could not have made a stronger case for some solution immediately to this present babel of tongues in science and engineering. For us it is becoming necessary to be familiar with at least three languages in order to keep up with the progress of modern science, and learning three languages, even including our own, is no small task, especially when coupled with a technical education.

I wonder if it would not be profitable to consider what has been done with Esperanto. Many international meetings have demonstrated its excellent applicability to international communication, both written and oral. I feel pretty sure that it would do away with many of the present difficulties.

L. A. WARE.

E. Orange, N.J., U.S.A., September 9th.

### LEISURE.

SIR,—Your leading article on the subject of "Leisure," calls aloud for comment. First, what is this "energy balance" law which you say insists that the purchaser of a motor car must, in some way, first expend an amount of energy equivalent to that which has been given to the construction of the car? Who measures this energy, and what is it which prevents the unoccupied daughter of a millionaire from acquiring a Rolls Royce until it is certain she has worked as hard as the makers of the car? Is it only the human energy which has to be so accounted, or is the energy expended through machinery also to be considered? This is a new law, of which I am so far unacquainted, and of which I thirst for more knowledge.

Secondly, you state what none can now deny, that production is outstripping consumption, and that the produce of industry, increasing in volume and variety as it is, requires the expenditure of less and less human energy, so that there is more and more leisure available for humanity. The position to-day is that there is leisure available equivalent to the two million unemployed workers in our midst. But this leisure is maldistributed. Too many workers have to put in too long hours; two

million workless, too short hours. And can the unemployed enjoy their leisure on the dole? More important, can they, with their dole, purchase the product of the unpaid machines which have replaced them?

Sir, is not the problem, simply stated, that purchasing power is lagging behind prices? Purchasing power is money. But what is money, whence comes it, and whither goes? Where, for instance, did the £8,000,000 spent upon the war come from?

We must face and solve this problem, or be overwhelmed in the crash which failure to do so must surely precipitate.

23rd September. ARTHUR WILLIAMSON.

[In answer to Mr. Williamson's question as to the energy-balance law—which we should have thought was fairly obvious—we would ask him to note the words "in some direction and in some manner." We did not wish it to be supposed that actual physical energy was involved. In the case of the millionaire's daughter, it is clearly the millionaire who has spent the money which has been acquired by energy exerted "in some direction or in some manner." "We cannot get something for nothing and very little for a halfpenny" is the old proverbial way of expressing the same law.—ED. THE E.]

## CONCRETE ROADS AND THEIR JOINTS.

SIR,—In view of the interest now being taken in concrete roads and their joints, and of the articles on the subject which have, from time to time, appeared in your columns, I think that your readers may, perhaps, like to have some particulars concerning a mile of concrete road which I built ten years ago in Cork, Ireland, and which has had no repairs done to it in the meanwhile, and still exhibits no

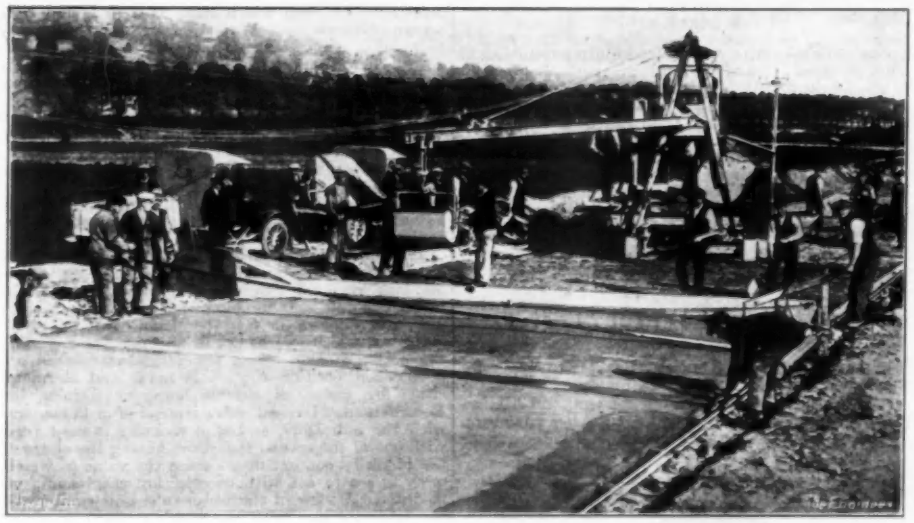


FIG. 1—CONCRETE ROAD IN CORK

defects. The road does not carry heavy, but what may be considered medium, traffic. I send, herewith, a photograph showing the road being made and a couple of drawings to illustrate the construction.

It will be seen from Fig. 2 that the road has an average thickness of 6in., being 7in. thick at the centre and 5in. thick at the sides; but the sides are, in effect, reinforced, both for bending and for expansion, by having the kerb—poured afterwards—attached to the base by short dowels, while the kerb itself is reinforced for expansion and some bending by two ½in. round bars.

The transverse steel reinforcement in the roadway is laid with a slight dip in the centre, so that it is approximately 2½in. from the under surface in the middle and about 2in. from the upper surface at the sides. This arrangement

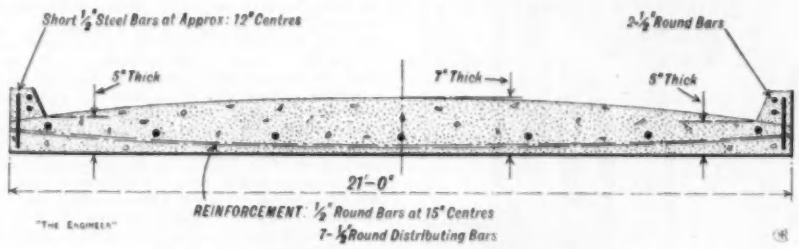



FIG. 2—SECTION OF CONCRETE ROAD

takes care of beam action in the centre and partial cantilever action at the sides. The reinforcing bars were not tied at every intersection, but the transverse bars were tied to the longitudinal bars at not less than three points in their length, which was sufficient to prevent displacement and meant only about one-third the labour that a tie at each point of intersection would have involved.

The concrete was what I term a 20 per cent. mixture; that is, of the total volume of finished concrete 20 per cent. was cement—counting cement as 90 lb. per cubic foot.

Instead of being laid in short sections the road was laid, on the average, in about 80ft. to 90ft. lengths, and two 80ft. to 90ft. lengths were normally laid in a day, one in the morning and one in the afternoon. At each joint there is a transverse supporting member of the form shown in Fig. 3 to prevent any relative movement between the sections. These transverse members were formed by digging a shallow trench, more or less of the shape indicated in the drawing, to coincide with the stopping of work at noon and in the evening, the trenches being, consequently, some 80ft. to 90ft. apart. Wooden pegs were driven at intervals into the soil and a stop board was attached to them, as indicated in the drawing, before the concrete was poured. The concrete, when poured, ran underneath the stop board into the trench, thus forming the transverse supporting member, which was not reinforced, and was trowelled off level on the far side before it set.

The processes followed in forming the road surface were as follows:—(*a*) The concrete after pouring was roughly levelled with shovels; (*b*) the surface was brought to contour by a long screed with double handles, the work being done transversely; (*c*) the ridges left by the screed were rolled out with a light broad roller, the work being done longitudinally; (*d*) the surface was finished by means of a belt 10in. wide, working transversely, with small movements backwards and forwards. This treatment leaves the surface with a slight "grip" and no further work is required. The screed, the roller, and the belt employed are all observable in Fig. 1.

In order to hold the tar paper—shown in Fig. 3 as coming between the concrete and the stop plank, it is "sandwiched" between the plank and a ¼in. thick soft pine strip of a width equal to the depth of the concrete. The strip is lightly tacked to the stop plank, so that, actually, the joints are ¼in. thick plus the thickness of the tarred paper. The soft pine strip is not, however, intended to take up expansion but to give a clean joint.

I am of opinion that, when such a road is laid at an average temperature, no allowance for expansion is necessary, the concrete being able, by elastic compression, to take up any expansion which may occur in warmer weather. I am also of opinion that expansion troubles start at the edge of the slab, and that, by forming an extension downwards, or an extension upwards, such as the kerb illustrated, most of the expansion and contraction difficulties can be overcome.

The greater length of the sections than is usual was purposely chosen because, in my view, the short section method of laying a road has the following disadvantages:

(1) There is always a tendency for the joints to be higher than the centre because the water is absorbed out of the concrete into the stop plank or board almost immediately, causing it to set first and leave a high point as compared with the centre. The result is the formation of a series of waves in the road surface, which set up a series of vibrations in the vehicles passing over it. These high points should be as few in number as possible.

(2) There is increased expense in putting in the greater number of transverse members under the joints, if they are adopted, and they are really necessary.

(3) It prevents such economical construction as is possible with the continuous slab.

(4) It assumes undue expansion and contraction in the slab.

In order to construct a successful concrete road, only first-quality materials must be used; first, because of the necessity of having a good wearing surface, which should be nearly as hard as concrete with a granolithic topping. Then, the strength should be such that the first tendency to crack, owing to expansion or contraction or to concentrated loads, may be resisted, not only by the concrete section at the point at which the stress is actually imposed, but by those adjoining it. The weaker concrete section will crack more easily because it lacks support from its neighbouring concrete. In other words, the angle of dispersion of stress is very much greater in good than in weak concrete, and therefore with it the tendency for the fracture to start is very much lessened, and if the edges are well taken care of—they being the points where trouble usually starts—most of the difficulties can be overcome.

Next to the quality of the cement, the quality and condition of the sand is of the greatest importance. Much damage can be done to concrete by using a friable sand,

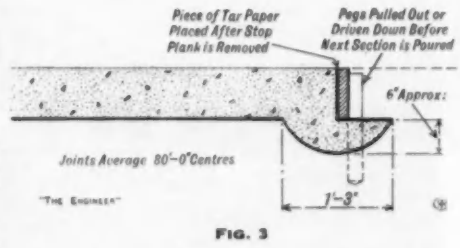

Piece of Tar Paper Placed After Stop Plank is Removed
Pegs Pulled Out or Driven Down Before Next Section is Poured
6"Approx:
Joints Average 80'-0"Centres
"THE ENGINEER"
1'-9"

FIG. 3

the particles of which become broken up by the grinding action of the mixing, thus introducing into the mixture the equivalent of a clayey material, which greatly reduces the value of the cement. A similar condition can arise owing to too long mixing. In other words, too long mixing or a poor aggregate would be equivalent to a clean aggregate plus several shovelfuls of fine dust thrown in and diluting the cement. H. C. JOHNSON, M.I. Struct. E.

September 17th.

## COST OF HELIUM.

SIR,—Your issue of September 19th contains an account of some remarks which I contributed to the discussion of three papers on airships which were read before Section G of the British Association on September 8th. I think that I ought to correct one statement which has been attributed to me, namely, that helium costs something like £5 per 1000 cubic feet. I have no data on which to frame an estimate of the cost of helium in this country, and what I said was that the use of helium in place of hydrogen would involve a cost of something like 5 *pounds* of useful lift per 1000 cubic feet—that is, about 11 tons in the case of "R 100" or "R 101." The reason for the misunderstanding—in a spoken contribution—is obvious.

Oxford, September 23rd. R. V. SOUTHWELL.

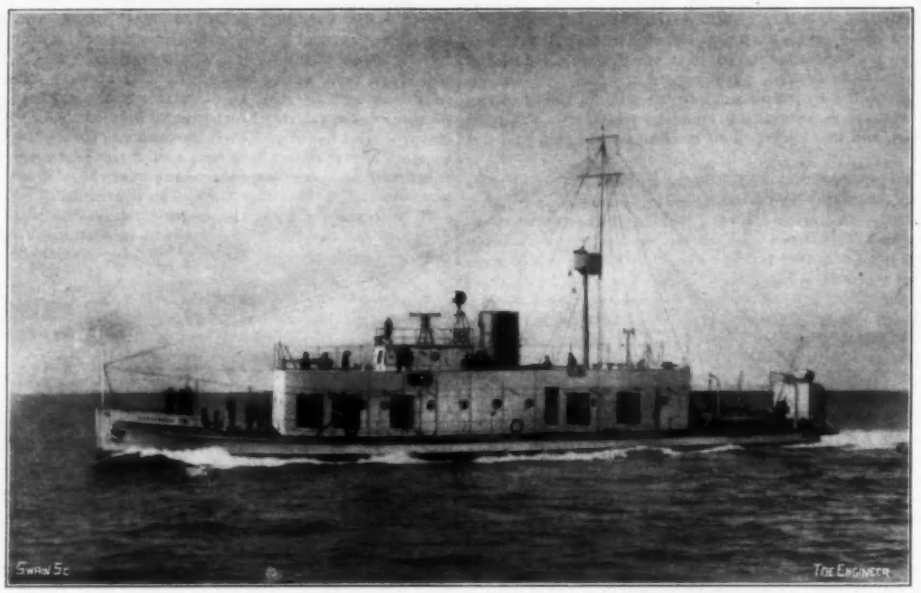
[The most recent price quoted for helium by the American Government is 34 dollars—say, £7—per 1000 cubic feet.—ED. THE E.]

## THE DETROIT RIVER TUNNEL.

REFERRED to in the "holing through" ceremonies as the first vehicular tunnel connecting two nations, the Windsor-Detroit tube, under the Detroit River, has been brought near to completion, and is expected to be formally opened to traffic next November. Until the completion of the Ambassador Bridge last year, traffic between Detroit and the Canadian Border Cities was, of necessity, handled by ferry steamers. Now, two international traffic ways span the Detroit River to provide for the annually increasing vehicular traffic at this point between Canada and the United States. The capital expenditure on each of these giant undertakings may be roughly stated at 20,000,000 dollars. The tunnel is just under a mile long from portal to portal, and will accommodate three lines of vehicles, though it is really only intended for two. The tunnel roadway is 21ft. wide and the clearance from road-bed to ceiling about 13ft. A system of large fans, arranged in ventilation buildings on both sides of the river, will keep the tube full of fresh air at all times. Work started on the project a little more than two years ago. Since then, shield-driven sections of the tunnel were built out from either shore. Nine steel and concrete tubes were sunk into the river to join up the driven sections and covered subway approaches were built at either end. The total length of the under-river section is 2197ft. Into this distance nine steel tubes, concreted to overcome buoyancy, were sunk into a trench prepared by dredging. The tubes average about 250ft. in length and are 35ft. in diameter. They were built by the Canadian Bridge Company at Ojibway, Ontario, partially concreted and towed up the river, where concreting was completed and the tubes sunk to their final resting place practically without incident. The shield-driven section in Detroit is 466ft. in length and on the Canadian side the similar work reached a length of 1223ft. to the point where junction is made with the ninth tube and where the final bulkhead was broken in the holing-through ceremony. On the Windsor end, Canadian contractors, the Northern Construction Company and J. W. Stewart, Ltd., carried through the work with despatch. A notable record was the driving of 20ft. of tunnel in 24 hours at the height of the "push." The tube under the Detroit River was put through by the Detroit and Canada Tunnel Company and financed both by Canadian and American capital.

# THE RIVER GUNBOAT "CARTAGENA"

YARROW AND CO., LTD., SCOTSTOUN, BUILDERS




## River Gunboats for the Colombian Government.

IN the accompanying engraving we reproduce a view of the oil engine propelled Colombian gunboat "Cartagena," one of three ships specially designed by Yarrow and Co., Ltd., of Scotstoun, Glasgow, for policing the river Magdalena. The "Cartagena" and her sister gunboats, the "Santa Marta" and the "Barranquilla," have safely arrived at their destination, crossing the Atlantic under their own power. The view we reproduce was taken during the trials of the vessel on the Clyde measured mile at Skelmorlie.

There are many shoals, reefs and sand banks on the river Magdalena, and the vessels are of special twin-screw design with raised propellers working in tunnels, in order to suit the arduous navigating conditions. The tunnels are fitted with Yarrow patented automatic flaps, which are designed to adjust themselves at varying speeds, so as to offer the minimum resistance and to maintain the tunnels filled.

This arrangement, it is claimed, gives a better combination of carrying capacity, speed and light draught than can be obtained with any other known system. To ensure rapid manœuvring qualities, two large rudders of the balanced type are provided.

The whole design embodies the results of Yarrow and Co.'s most recent experience in Mesopotamia, and on the Yangtsekiang River, and it embraces important improvements suggested by model experiments which have been made at the National Physical Laboratory tank, Teddington. Particular attention was paid to the ventilation of the machinery spaces and cabins, having in view the hot climate in which the vessels will be called upon to serve.

The main dimensions of each of the ships, which are identical, are:—Length, 137ft. 9in. (41·9 m.); beam, maximum, 23ft. 6in. (7·16 m.); draught, 2ft. 7in. (·80 m.). The designed speed, 15·5 miles per hour (25 kiloms. per hour), was exceeded on trial, and is high for this type of craft.

As regards the constructional features of the design, the hull is made of galvanised steel, and is provided with adequate subdivision, while the machinery spaces, magazines, and cabins are protected by bullet-proof plating. The cabins, which are well ventilated and airy, are situated on the main deck, and above them is the battery deck carrying the armament, which consists of one 75 mm. gun and four machine guns. There is a wireless telegraphy installation, a searchlight, and a rangefinder, and, as our illustration shows, a military mast with fighting top aft. Electric lighting has been installed throughout, and a refrigerator forms part of the auxiliary equipment. The deck auxiliaries include a motor-driven capstan with a vertical spindle which is placed on the main deck forward, and an electric capstan aft. Two steel motor launches are carried at the stern and extensive sun awnings are arranged for, while the outfit of equipment and stores is a very complete one.

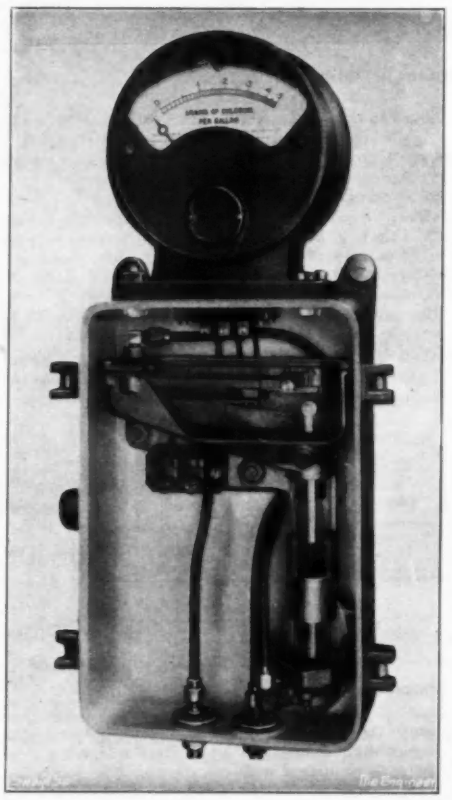
The propelling machinery comprises two Gardner engines, each designed to develop 300 B.H.P. at 290 r.p.m. The engines are Norris, Henty and Gardners' "J" two-stroke type, operating with high compression ignition. Each engine is furnished with a friction clutch and a thrust bearing, and other auxiliary attachments include a special marine governor and variable-speed gear, a two-stage air compressor, circulating water pump, bilge pump, compressed air bottles, and other desirable accessories. In addition to the main engines, there is an auxiliary compressing and pumping set and also an oil engine driven generator set.

All three ships were tried out on the Clyde, with, we learn, highly successful results, a feature of the trials being the small amount of vibration which was experienced.

The gunboats have now been delivered to Colombia, after crossing the Atlantic under their own power and alone. The first left at the end of April, the second in May, and the third in June, and Messrs. Pedder and Mylchreest were responsible for the arrangements. It is probably the first time that small vessels of this type have undertaken such long voyages, and it is a noteworthy testimony to their design and structural strength that the long cross-Atlantic trips were successfully accomplished without incident. One of the gunboats made the journey from the Clyde to the Magdalena River in twenty-four days, making one call only, namely, at St. Vincent. The firm of Yarrow and Co., Ltd., has been responsible for the design and construction of practically all the river gunboats built for the British Navy for many years, including H.M.S. "Gannet," "Peterel," "Seamew," and "Tern," and it may be mentioned that there is now under construction at Scotstoun H.M.S. "Falcon," one of the latest gunboats ordered for Admiralty service.

## A New Dionic Water Tester.

THE portable type of Dionic water tester made by Evershed and Vignoles, Ltd., for testing samples of water for impurities is well known to our readers, and has, no doubt, proved of considerable value to many engineers. It does not, however, provide continuous indication or record, and to meet the need for an indicating or recording type of instrument a new Dionic water purity meter has been developed. The new instrument is based on the same principle as the portable water tester, namely, that the electrical resistance of a dilute solution is a measure of the impurities present, but it is entirely automatic, and deals with a continuous flow instead of with individual samples. After it has been installed it requires no attention, for its operation is quite automatic. For changes in the temperature of boiler water or condensate, automatic compensation is provided, and in view of the fact that the temperature coefficient is in the neighbourhood of 2 per cent. per degree Centigrade, this is an important consideration. The apparatus can be operated direct from direct-current mains or from alternating-current mains through a rectifier, and is unaffected by changes in the supply voltage.



INDICATING WATER TESTER

The equipment includes the usual water-tube unit, one or more indicators or recorders, and if required an indicator fitted with an adjustable device to give warning when a predetermined amount of impurity is shown. When the equipment is to be used for several boilers, a mixing chamber may be supplied, so that the normal measurement is of the impurity content of the boilers as a group, while any one may be selected if the impurity content rises at any time. If desired, the units can be supplied separately, the water tube being mounted in the boiler-room, while the indicator or recorder is on the main control board or in the chief engineer's office. Alternatively, the apparatus is supplied as a combined instrument. Since the apparatus is electrically operated, indicating or recording instruments may be placed at any distance from the water-tube unit.

The water tube is contained in a water-tight metal case, having a gland through which a two-core cable passes, and unions to which the water supply pipes are connected. Internally it is of the simplest construction, consisting merely of the glass tubes with an insulated separator which provides the measured path and the simple compensator for changes in temperature. The water which is by-passed from the condenser or boiler enters by way of the union at the right-hand bottom part of the case, passes through an insulating tube to the bottom of the casing below the glass tube, through the measuring glass tube to a metal receptacle above, which contains the temperature compensating device and out through an insulating tube, down to the other union. The electrical resistance measured is that between two electrodes in the glass tube between which there is a measured path of known dimensions. Variations of temperature cause bi-metallic strips to move plungers in the tube up and down, thus altering the quantity of water under test, according to the temperature, the temperature compensation being arranged to be operated continuously over the ranges of temperature normally applicable to condensate, &c. The tubes are designed to withstand a pressure of 40 lb. per square inch, and are very robust, and the apparatus is not damaged by a glut of water of high impurity content. Moreover, the parts of the water tube are all standardised, and can readily be replaced without having to return the apparatus to the makers for recalibration.

The indicator consists of a specially constructed indicating ohmmeter in a metal case, the instrument dial being 5in. long when the water tube and indicator are combined in a single unit, and 7in. long when supplied as a separate unit. If desired, it may be fitted with an auxiliary indicator, which can be set to any particular reading on the scale, so that when the indicator reaches a predetermined position contact is made and alarm given, either by means of electric horns or warning lamps. Recorders may be used either instead of or in conjunction with the indicators, and if a recorder is used together with one of the special indicators having the alarm relay, the impurity content may exceed the value at which the relay is set to act without affecting the reading of the recorder. A view of the water-tube unit combined with the indicator and with the case cut away to show the temperature compensating device is shown in the accompanying illustration.

## SIXTY YEARS AGO.

THE well-regulated systems of sewage disposal with which this country is to-day blessed are the products of less than sixty years of progress. In 1870 the problem was just beginning to receive scientific attention. Much that we would now consider intolerably foul still attended the collection and disposal of the excrementitious matters of most large towns. The British Association was, however, endeavouring to arouse urban authorities to the importance of the problem and of devising improved methods for its solution. Its efforts were not at first notably successful, for many of the authorities which it approached expressed complete contentment with their existing systems. Manchester was a notable exception. It was striving to improve its sanitation and was proud of the results which it had so far achieved in that direction. The general situation can, however, be realised when it is noted that even in Manchester the authorities still objected to the use of water-closets in cottage dwellings. Why they preferred the dry to the wet system was made clear in a paper which Alderman Rumney read before the British Association at its Liverpool meeting and which was reprinted in our issue of September 30th, 1870. It was held that in the limited space available in houses occupied by the working classes water-closets would prove a greater nuisance than the outside privy and ashpit. They would, too, cause a loss of valuable manure. Finally, in view of the rapid increase in the population and the limited area of the watershed from which the city drew its supplies, the time was coming, so it was argued, when all the available water would be required for domestic and manufacturing purposes and when none could be wasted (*sic*) in water-closets. So Manchester decided to introduce an improved form of dry privy and ashpit. The principles adopted are sufficient comment on the system which it was desired to abolish. The privies were to be roofed over in order to exclude rain from their contents. Rain water from the yard and slops from the house were to be drained elsewhere than into the ashpits of the privies. Besides the excrementitious matter, nothing but dry ashes from the house fires was to be admitted to the pits. Flues were to be provided to carry the gases generated in the pits upwards to a point above the eaves of the houses. It was recorded with satisfaction that the inhabitants of those houses at which these improved privies had been provided now found it possible to open their back bedroom windows every day, and that during the summer months they experienced

immunity from diarrhœa and fever. There were about 38,000 ashpits of all sizes in Manchester at that time. Some of them were sufficiently large to require emptying only once a year. On the average the contents were removed two or three times a year. The Health Committee made it a point in the design of the new privies that they should be much reduced in size in order to necessitate more frequent clearing. Its ultimate aim was to make the pits so small as to require the removal of the contents every two or three weeks. It was, however, realised that it would be difficult to effect such a great change all at once. It may be added that the city authorities' efforts at improvement were strongly opposed by a body called the Associated Property Owners' Association, and that in spite of the powers possessed by the Corporation and the stringent clauses of the then newly passed Artizans' Dwellings Act, the opposition was in many cases too powerful immediately to be overcome.

## New Cunard Ships.

WE learn that the following statement has been issued to the shareholders of the Cunard Steamship Company by the chairman, Sir Percy E. Bates :—

As the next ordinary annual meeting of the company is no less than six months away, and as so much interest and discussion has been raised by the company's proposals for the building and insurance of a new steamer, I think it well to anticipate the speech that I should ordinarily be making to the shareholders next April and explain now what are the economic factors behind our proposals.

With what is called "The Blue Riband of the Atlantic," the Cunard Company to-day is but indirectly concerned. If it can be obtained it will be a valuable advertising point, but its attainment is merely incidental to a far bigger fact.

For the first time in the history of naval architecture it is a practical proposition to run a weekly service from Southampton *viâ* Cherbourg to New York, with two steamers which can pay. Hitherto such a service has required three steamers.

The conditions which govern the construction of such a pair of steamers are speed and size. The speed is dictated by the time necessary to perform the journey at all seasons of the year and in both directions, plus the considerations of the number of hours required in port on each side of the Atlantic. The size is dictated by the necessity to make money by providing sufficient saleable passenger accommodation to pay for the speed.

In the opinion of its technical advisers, so far from attempting to construct steamers simply to compete with others in size or speed, the Cunard Company is projecting a pair of steamers which, though they will be very large and fast, are in fact the smallest and slowest which can fulfil properly all the essential economic conditions. To go beyond these conditions would be extravagant ; to fall below them would be incompetent, as the company would be simply leaving to others a direct invitation to compete with it on more economic terms.

Had the company been projecting costly ships without a real economic basis, it would never have dared to approach his Majesty's Government on the matter of insurance, but in view of the facts described above, it had no hesitation in so doing. The thanks of the company are due to the Government for the sympathetic reception of the proposals, as lacking their agreement it would not have been possible to proceed at the present time.

Even before the war a serious problem existed with regard to insurance of the largest class of steamer, and it was only the outbreak of hostilities in August, 1914, that cancelled a mutual insurance scheme which had been entered into by the Cunard Company and some of its competitors, foreign as well as British.

After all, these ships are, and always will be, relatively few in number, and it is not to be wondered at if the marine insurance market should find itself unable to deal with these specialties. At the same time, I would like to express the hope that when the time does come to place the insurance on this ship, the expansion of the ordinary marine insurance market may render the Government agreement redundant.

The present position is that the matter of dry-docking at Southampton has still to be settled with the Southern Railway, and negotiations with the builders are actively proceeding with a view to settling the terms of the contract and so far as is possible the final price of the first steamer.

## B.E.S.A. SPECIFICATIONS.

### LECLANCHE TYPE PRIMARY CELLS.

THE British Engineering Standards Association has just issued a new specification, No. 397–1930, for Leclanché type Primary Cells. This specification deals with cells of which the elements are zinc, carbon, manganese-dioxide and ammonium chloride, and covers dry, inert and wet types of cell. Standard dimensions are given for the various types of cell, together with the appropriate connecting wires and terminals, and standard requirements for zinc, and for the electrolyte for wet cells are also laid down. Tests are given to ensure compliance with the specification, these comprising tests for initial internal resistance, polarisation and output, while an Appendix dealing with an optional storage test is also included. Copies of this Specification, No. 397–1930, may be obtained from the Publications Department, British Engineering Standards Association, 28, Victoria-street, S.W. 1, price 2s. 2d. post free.

THE demolition and reconstruction of a building in New York only six years old must constitute a record. The building was acquired for the extension of a departmental store and was pulled down because the floor levels did not coincide with those of the existing store.

## Provincial Letters.

### THE MIDLANDS AND STAFFORDSHIRE.

*(From our own Correspondent.)*

**Sluggish Market.**

THE anticipated autumn demand has not yet revealed itself. Demand for iron and steel by Midland manufacturers is no better than in recent weeks, and the attendance on 'Change in Birmingham to-day—Thursday—was small enough to suggest that sellers have little hope of making their attendance profitable. Small in number as producers were, buyers were even scarcer. The small scale business which was transacted was put through, in practically all instances, at last week's selling rates. Those members of the Exchange who had looked for an improvement in business at the end of September are becoming discouraged. There are as yet no tangible evidences of the new trade impulse which normally begins to make itself felt at this time of the year.

**Raw Iron.**

Work at the foundries and forges in the Midlands shows no expansion, and there is no need to buy pig iron in large quantities or to contract forward for supplies. Midland blast-furnacemen are seeking specifications, but are only able to obtain orders for delivery of small tonnages. The position is decidedly worse than it was at the beginning of September, and unless business rapidly improves curtailment of output will have to be resorted to, especially in Northamptonshire. Up to now little has been done in this district to regulate the ratio of supply and demand of foundry and forge grades of iron, and the considerable stocks now held by some furnaces can hardly be increased with safety. The position gives cause for a good deal of uneasiness, for, unfortunately, the outlook is not at all encouraging. On the bright side has to be placed the fact that consumers' and merchants' stocks have very generally fallen to a low level, and even a slight increase of activity at the consuming works would almost immediately be felt by blast-furnacemen, whereas under normal conditions it would take some time to reach the producer of raw iron. Coke prices are becoming firmer, and, indeed, it is stated that ovenmen have this week been successful in obtaining somewhat higher prices than of late. If this statement is correct, then the better position in which coke makers find themselves is due to the winter call for supplies from the domestic market, and to the improvement in the export trade which usually develops about this season. Values of Midland brands of forge and foundry pig are unchanged, sellers adhering to the basis fixed by the Central Pig Iron Producers' Association.

**Steel.**

Orders for steel are not increasing either in frequency or size, and makers report them to be difficult to secure. Consumers of most classes of steel have more material in stock than present conditions indicate they will be able to utilise for some time. They are naturally unwilling to place fresh orders, especially as they regard the prospects of a higher range of values as unlikely. Midland structural engineers are only partly employed. Though at present contracts are not easy to negotiate, even with finely cut prices, recent inquiries indicate that there is the prospect of a greater amount of work coming into the market in the very near future. Steelmasters are maintaining their prices, being of opinion that reductions would fail to bring any marked accession of business. Heavy steel values are :—Angles, £8 7s. 6d.; joists, £8 10s.; structural plates, £8 17s. 6d. In the half-products department, the market is settling down and business is taking its customary course. Consumers of continental material are adding very little to their commitments, even though merchants are offering billets at prices below the minimum acceptable to producers. As low a figure as £4 12s. 6d. has been mentioned as a possible basis for business. There is a tendency to slightly firmer quotations, however, in this branch. Foreign steel bars are offered at £5 7s. 6d., delivered, but local re-rollers assert that they can buy at a lower price.

**Finished Iron.**

Business continues dull in the Staffordshire finished iron trade. Iron masters are receiving a number of orders for marked bars, strip and other descriptions of finished material, but demand is much below productive capacity. In the best bar mills work is fairly regular, and makers are able to dispose of the greater part of their output. Selling prices are upheld at £12 10s. In the Crown bar department slack conditions rule. Orders are small and fitful, while values range from £10 to £10 7s. 6d. per ton. Common bars for the nut and bolt and fencing trades can hardly be said to be in demand at all. Most of the works in this district are using continental raw material. Native bars are impossible if the manufactured articles have to be sold in the open market. The quotation of £9 per ton for common bars of Staffordshire make is regarded as merely nominal. Wrought iron tube strip is in relatively good demand at £11 2s. 6d., makers competing successfully for orders, despite the fact that steel tube strip is to be had at round about £8 per ton and continental strip at £6 5s.

**Galvanised Sheets.**

The reduction of 5s. per ton in the selling price of the thicker gauges of galvanised sheets does not appear so far to have led to large export buying. It was stated a week ago that fairly substantial tonnages of sheets were likely to be bought on export account if manufacturers decided upon lower values. Production costs in the shape of cheaper spelter and sheet bars enabled them to take this course, but as far as can be gathered, the anticipated influx of business has not occurred. It is hoped that it will not be much longer delayed, for mills can well do with new orders to take the place of those rapidly being completed. The price revision does not extend to sheets of 30 gauge and upwards. The scheduled price for 30 gauge is £15 7s. 6d. and for 24 gauge corrugateds £11 12s. 6d. per ton f.o.b. Buying on home account is maintained at the recent level, and is considered reasonably good. It is a long time since exports of galvanised sheets were so small as they were last month, when shipments fell below 28,000 tons.

**Furnace Closed Down.**

It is announced that Alfred Hickman—branch of Stewart and Lloyds, Ltd.—of Bilston, Staffs., have closed down a melting furnace. A blast-furnace was closed down about a month ago. An official of the firm this week said that the state of the steel trade is serious, and the whole of the Black Country is, in his opinion, in for a very bad winter. The closing down of the furnaces is due entirely to the depressed state of the iron and steel trade, and will affect some 100 men, who will have to go on short time.

**Steel Wagons for Brazil.**

Orders for rolling stock for overseas railways continue to find their way to Midland firms, and although they are admittedly small, they are none the less welcome. An order has just been received by the Metropolitan-Cammell Carriage, Wagon and Finance Company, Ltd., from the San Paulo (Brazilian) Railway for two 30-ton all-steel bogie well wagons. Midland rolling stock establishments are at date moderately employed, but order books are not so well filled as they were some time ago.

### LANCASHIRE.

*(From our own Correspondents.)*

MANCHESTER.

**Second-hand Plant.**

WHAT happens to much of the industrial plant that reaches the second-hand stage is a question that can readily be answered by the large quantities of scrap that are now being offered on the various markets at low prices. So cheap are supplies of scrap iron that sellers of pig iron now regard the material as a factor which, more than ever before, tends to limit the demand for foundry iron, the consumption of scrap relatively to the latter being on an increasing scale. The cotton trade slump of the last few years has had the effect of throwing large quantities of textile machinery on to the second-hand market. By far the greater proportion of it has been out-dated or outworn and has had little influence on the market for new machinery. One authoritative estimate of the fate of discarded spinning machinery is that only about 20 per cent. is sold for introduction into fresh industrial units, most of it in this country, the remainder helping to swell the tonnage of scrap. Textile machinery scrap is usually of good quality and finds a fairly ready market at a slight premium over ordinary grades of scrap castings.

**Industrial Results.**

Three important dividend announcements made by Lancashire engineering concerns during the past week indicate, in two instances in particular, results which are anything but satisfactory. Against 9 per cent. in 1928–29 and 10 per cent. in each of the four years from 1924–25 to 1927–28, the ordinary shareholders of Dobson and Barlow, Ltd., textile machinery manufacturers, Bolton, are to receive only 2½ per cent. for the twelve months to the end of last June, a net loss of £16,607 having been sustained compared with a profit of £44,408 in the previous year. The dividend distribution has been made possible by the allocation of £25,000 from the general reserve fund, the amount carried forward being £7960, against £18,860 a year ago. The dividend for the six months to the end of September on the preference shares of John Hetherington and Sons, Ltd., of Manchester, who are also textile machinery makers, has been passed, as it was in the previous half-year. No profit statement has yet been made by the directors of the Vulcan Foundry, Ltd., locomotive builders, of Newton-le-Willows, but the fact that the ordinary shareholders for the twelve months ending June are to receive only 7½ per cent. dividend, compared with 10 per cent. in 1928–29, when the profit amounted to £94,025, points to a less satisfactory financial year. The announcement of an order for locomotive cylinders and parts placed with the Vulcan Company by the Indian State Railways has been made during the past week.

**Saving Water on Gas.**

Considerable financial savings on water costs are claimed for an invention of Mr. A. L. Holden, the Manchester Corporation Gas Engineer, which has been adopted at the Corporation's Partington gasworks. The object of the invention is to save the water supply for the gasholder tanks by trapping and passing it through a conduit for use again instead of allowing it to run to waste. Reference to Mr. Holden's invention was made at the last meeting of the Corporation Gas Committee, successful results, it is stated, having attended its adoption.

**Non-ferrous Metals.**

Weak markets throughout the non-ferrous metals group have been experienced during the past week. Successive reductions in copper prices have had little influence so far on stimulating the industrial demand for the metal, although speculative transactions have been by no means absent since my last report. The fact is, of course, that the market is still overburdened with stocks, and as users are not yet convinced that prices will not reach lower levels there is no disposition on their part to enter into extensive commitments. The loss of about £1 a ton on balance for the week has brought current values below what they have been at any time during the past thirty years. Trade demand for tin has also been subdued and the steadier tone apparent a week ago has not been maintained, prices declining to the extent of between £2 and £3 a ton. In this section, however, hope is still expressed, based on expectations of a change in the statistical situa-

tion, that a steady upward movement will set in before long. Buying interest in the case of lead has been of moderate extent, and here again, after a period of several weeks of reasonably steady prices, reaction has to be recorded, quotations being lower by about 5s. a ton. Only a comparatively small business has been done in spelter, and on balance a rather substantial fall in values has occurred.

### Iron and Steel.

So far as new orders are concerned, there is a distinct tendency among Lancashire users of both iron and steel to proceed cautiously in the hope—more pronounced, perhaps, in the case of steel—of securing some measure of price advantage. Pig iron sellers report very little new business this week, although there has been no apparent contraction in total deliveries for consumption. In the meantime Derbyshire and Staffordshire foundry iron for delivery equal to Manchester are at 72s. per ton, with forge quality at 67s., Scotch makes at about 92s. 6d., and West Coast brands of hematite at 85s. to 86s. Bar iron is unchanged at £10 5s. per ton for Lancashire Crown quality and £8 15s. for No. 2, with sales on quiet lines. In no branch of the steel-using industries locally has there been any expansion in the demand for materials, a disappointing feature of the present situation being the slow rate at which supplies against contracts are being requisitioned. Joists, plates and bars are all more or less uniformly affected in this respect. Boiler plates are easy at about £9 12s. 6d. per ton, as are also small re-rolled bars at from £7 12s. 6d. to £7 15s.; otherwise the market shows little change on the week. Further declines, however, have to be reported in imported products, continental semi-finished materials being quoted for delivery equal to Manchester at about £4 5s. per ton, sections at £5 5s., joists at £5 2s. 6d., wire rods at £5 18s. 6d., Thomas plates at about £6 5s., steel bars at £5 5s., and bar iron at £5 7s. 6d. Notwithstanding the exceptionally low prices, however, buyers are showing no anxiety at the moment to enter into forward contracts of any important weight.

BARROW-IN-FURNESS.

### Hematite.

There is still an entire absence of any sign of recovery in the hematite pig iron market. Customers are only taking moderate tonnages, sufficient for immediate requirements, and there is no tendency to place orders for forward delivery. Home requirements are moderate and continental business is poor. Owing to quietness in the steel departments local requirements are very small indeed. Stocks are rising in most works. The local iron ore market is dull. Outside business is down and local demands are restricted. Foreign ore is in moderate demand. The steel market is very quiet and the rail mills at Barrow are idle. Interest has been quickened by the report of Canadian requirements for rails, and hopes are expressed that if the contract is given out Barrow will get its share. The hoop mills and small section mills are moderately employed.

### Shipbuilding.

Vickers-Armstrongs are to overhaul the machinery for the Cunarder "Carinthia" at Barrow in the early future. This vessel was built at Barrow, and when delivered was specially fitted for luxury trips to the Mediterranean and round the world.

## SHEFFIELD.

*(From our own Correspondent.)*

### Steel Trade Depression.

CONDITIONS in the open-hearth steel industry remain unchanged. Extensive plant is idle and there are no signs that it will be occupied again in the near future. Inquiries, it is true, are inclined to be more numerous than they have been recently, but there is no movement of a very encouraging nature. Slight improvements in activity are reported from certain firms, but no substantial new orders have been obtained. Manufacturers of alloy steels and high-speed steels also are experiencing lean times. Official quotations for steel are unchanged, but competition to secure work is so keen that price-cutting is inevitable. A good idea of the extent of the depression is provided by the fact that the output of steel ingots and castings during last month—451,300 tons—was the lowest recorded for many years, being 187,000 tons less than the average monthly output of 1913, when the productive capacity of the trade was very much below what it is at the present time.

### Trade Mission's Message.

The Industrial Mission from Sheffield, headed by the Master Cutler, Mr. A. K. Wilson, appears to be doing good work in South America. A cable received from one of the delegation, Mr. C. R. Hodgson, states:—"Excellent receptions everywhere; magnificent support Government officials, Chambers of Commerce; well satisfied results; every confidence success." After sixteen days' stay in Argentina, the Mission will visit Uruguay, Chile and Peru. Great hopes are entertained for substantial results from the tour, for extension of trade abroad is urgently needed. It is also hoped that orders for the supply of British steel to Canada may result from negotiations now taking place in Montreal regarding the Canadian National Railway's £10,000,000 scheme for a new railway terminus in Montreal. It has been estimated that a total of 56,000 tons of steel will be required in the construction of viaducts and the new passenger station.

### Government Contracts Secured.

Several firms in the Sheffield district have obtained Government contracts. For the Admiralty contract and purchase department steel discs, sheets, plates and rods are to be supplied by Swift, Levick and Sons, Ltd., Sheffield, Rotherham Forge and Rolling Mills Company, Ltd., Rotherham, and Beardshaw and Son, Ltd., Sheffield. Forged steel propeller shafting is to be supplied by William Jessop and Sons, Ltd., Sheffield. For the War Office, horseshoes are to be made by W. Cooke and Co., Ltd., Sheffield; and woven wire fencing by the Darlington Fencing Company, Ltd., Doncaster. Bench vices are to be supplied to the Air Ministry by C. and J. Hampton, Ltd., Sheffield, and railway tires are to be made for the Crown Agents for the Colonies by J. Baker and Bessemer, Ltd., Sheffield.

### Sheffield and New Flying Boat.

A flying boat larger than any ever built in this country is to be built by Vickers, Ltd., for the Civil Aviation Department of the Air Ministry, and this order will mean work for Sheffield, since the greater part of the hull will be built in the local works of Vickers. Stainless steel, which experience has proved to be specially suitable for such hulls, will be used. The hull will be 100ft. in length and 18ft. high. The boat will weigh 33 tons when loaded and will have accommodation for forty passengers. Twenty passengers will be able to sleep in detachable bunks. The machine, which will be a monoplane with a span of 174ft., will have a petrol tank holding 2250 gallons, and will be driven by six 900 H.P. Rolls-Royce engines. Wind tunnel tests give it a maximum speed of 145 miles an hour. It will have a maximum range of 1300 miles.

### New Stainless Steel Firm.

The creation of the Universal Rustless Steel Corporation, Ltd., which is to operate the Crysteel Works, Coleridge-road, Sheffield, and the Calver Mills, Calver, has aroused considerable interest in local trade circles. The company, which has a nominal capital of £165,000, has been formed principally for the manufacture of rustless steel commodities by three new processes acquired from Mr. P. R. Kuehnrich, a well-known Sheffield industrialist and inventor of alloy steels, who is to be the managing director. In connection with the new processes patents have been applied for, and in respect of two of these arrangements have been concluded with Krupps, of Essen, for the granting of a licence in Germany on a royalty basis. By the processes, it is claimed, costs of stainless steel can be reduced considerably. Special plant has been secured for the manufacture of all kinds of fittings, precision-machined bright components, &c., and rustless cutlery will also be produced. An up-to-date marketing scheme is to be arranged by the firm, which at present is a private company.

### New Trams and Motor Omnibuses.

The Leeds Corporation Tramways have ordered complete electrical equipment for fifty tramcars from the General Electric Company, Ltd., London. Each equipment consists of two G.E.C. standard traction motors, each developing 50 H.P. on a one-hour rating, 500 volts two-drum type controllers arranged for rheostatic braking, circuit breakers, current collector gear and resistances. A heavy oil engined double-deck motor omnibus has also been acquired and put into service by the Leeds Corporation. It has a six-cylinder 80 H.P. engine, and it is claimed that the omnibus can run 100 miles for a fuel cost of 2s. 7d., as against 100 miles for 16s. 6d. by a petrol omnibus.

### Steel Making Lectures.

The Sheffield Junior Chamber of Commerce has secured the co-operation of the Applied Science Department of the University of Sheffield in arranging a course of lectures specially designed to give commercial men sufficient information about the manufacture of steel, its types, properties and uses, &c., to enable them to understand better technicalities which they meet every day. The lectures will be given, as far as possible, in non-technical language, and opportunities will be provided for questions and discussion.

### New Technical School.

The Castleford, Normanton and District Mining and Technical Institute, situated at Whitwood, has been formally opened by Lord Crawford and Balcarres. It cost approximately £40,000, and includes laboratories for electrical engineering, heat engines, testing of materials, mechanics, physics, chemistry, and mining practice. The Miners' Welfare Committee contributed £21,250 towards the cost of the building.

### Lighter Trades' Position.

Conditions of the cutlery, tool and similar trades in the Sheffield district are far from satisfactory. Cutlery and plated goods manufacturers report a lack of the usual extra business in connection with the Christmas season trade, and there has been a substantial reduction in the calls from overseas markets. There is a slightly brisker demand for spoons and forks and the cheaper electro-plated ware. File factories are only employed for two or three days a week, business having been bad during the whole of the year and showing no signs of great improvement now. Reduced buying from overseas is affecting the toolmakers in a serious manner. Exports of cutlery last month amounted to £33,000 less than the previous month, and £40,000 less than in the corresponding period of last year. Reduced buying by Australia had a great deal to do with this result, and Sheffield has been hardly hit by the falling away of orders from that Dominion.

### Water Service Reservoir.

The Dearne Valley Water Board has decided to proceed with the reconstruction of a service reservoir at Jump, near Barnsley, at a cost of £9000, subject to the approval of the Ministry of Health and provided the requisite financial assistance is forthcoming from the Unemployment Grants Committee. The proposal is to erect in place of the existing reservoir two reinforced concrete tanks of 500,000 gallons capacity. The water is received into this reservoir from the pumping station at Broomhill and also from the Sheffield mains, and is distributed throughout the Dearne Valley. This reservoir burst some weeks ago, causing floods and considerable alarm in a section of the village of Jump.

## NORTH OF ENGLAND.

*(From our own Correspondent.)*

### Another Big Order for Tyneside.

ANOTHER very welcome order for Tyneside is announced. Sir W. G. Armstrong, Whitworth and Co., Ltd., have secured the contract for three heavy oil mobile electric power-houses and one heavy oil electric locomotive for the Buenos Aires Great Southern Railway, a concern financed mainly by British shareholders. The mobile power-houses generate electricity directly to the carriages of an electric train, obviating the pick-up or overhead system. Armstrong-Whitworth's are fortunately situated to undertake this class of work, as some months ago they established an oil engine department for the manufacture of oil engine generating machinery. The locomotive department of the firm is fairly busy. It is building twenty-five locomotives for the Great Western Railway and twenty locomotives for the London and North-Eastern Railway.

### Cleveland Iron Trade.

The position in the Cleveland pig iron trade is still very disappointing. There has been no substantial expansion in the autumn demand from home consumers, and the volume of exports is very restricted indeed. The best that can be said is that pig iron output is passing steadily into consumption, and some reduction of stocks has been possible, but it has not been sufficient to inspire the hope of any more blast-furnaces being restarted. There is a little forward inquiry, but for the most part sales are confined to early delivery on the basis of 63s. 6d. for the standard No. 3 quality. No. 1 foundry iron is 66s., No. 4 foundry 62s. 6d., and No. 4 forge 62s.

### Hematite Pig Iron.

East Coast hematite pig iron inquiries on home and export account are slowly but steadily expanding, and sales by both makers and merchants include fairly substantial quantities to firms abroad. The difference between hematite and Cleveland pig values is nearly the same as that which ruled in normal pre-war days. To meet requirements, stocks are being drawn upon to some extent, and both producers and merchants are taking a firmer stand. Ordinary qualities of East Coast hematite are 71s. and No. 1 is 71s. 6d.

### Ironmaking Materials.

Definite prices for foreign ore are difficult to fix. Sales are few, consumers being well bought ahead. For best Rubio 19s. c.i.f. Tees is asked, but consumers state that they can purchase at considerably less. Blast-furnace coke is firmer. Sellers hesitate to entertain offers at below 17s. for early delivery of good average qualities, and ask 17s. 6d. to 18s. for supply over periods up to the end of the year.

### Manufactured Iron and Steel.

In the manufactured iron and steel trade there has been an alarming contraction in the flow of orders. Foreign material is not now offered at sacrificial prices, but the market is thoroughly disorganised, and buyers are adopting an attitude of extreme caution. The dearth of orders, too, is accentuated by the economy campaign on the home railways. It is understood that lack of demand may lead to a revision of the minimum prices for galvanised sheets, but no price changes have yet been made.

### Steel Mills Closing.

Consequent upon the acute depression in the iron and steel trade, Dorman, Long and Co., Ltd., Middlesbrough, have decided to blow out one of the three blast-furnaces making steel works iron at their Acklam Works, and also to close down the steel mills. The mills have only been working six shifts out of seventeen, but it is hoped that the closure will only be temporary. This means that there will be now only 25 furnaces in blast on the North-East Coast, as against 44 less than a year ago.

### Shipbuilding.

Swan, Hunter and Wigham Richardson, Ltd., have booked an order for a small passenger steamer for Yugo-Slav owners. It will be built at the Walker Neptune Yard. Very few inquiries for new tonnage are circulating just now, however, and the winter prospect for the North-East Coast shipyards is not bright. There is a glut of merchant vessels all over the world. At the beginning of September there were 112 vessels laid up in the Tyne, the largest number recorded in the history of the river. A few of the large boats have got into service again, but there is still no appreciable diminution. Soon the Baltic seasonal trade will be over, and many steamers will return to swell the market for available cargoes in other directions.

### The Coal Trade.

The completion of the coal-marketing schemes is drawing nearer, but it is probable that before they are ready foreign consumers will have bought extensively abroad, as their expectation is that British coal will not be cheaper, but may be dearer. The outlook gives no sign of being brighter. The pits are working irregularly, and the recent short time periods are likely to be maintained. Best Northumberland steams are plentiful and easy in tone at the stabilised minimum of 13s. 6d. for large and 10s. 6d. for small. Durham kinds are steady at 14s. 9d., but through contractors lower figures are indicated for definite shipment dates. Tyne prime or similar best screened are on offer at 12s. 9d. and small at 10s. 6d. The Durham gas coal trade remains disappointing. Although production is still heavily curtailed, the supply is much in excess of requirements. Best grades are easily obtained at 14s. 6d. to 14s. 9d., and good secondary qualities at 12s. 6d. Durham coking unscreened are pressing on the market at 12s. 6d. to 13s. The bunker trade is dull, and, with supplies plentiful, prices are weakly held at 13s. 6d.

for superior and 12s. 6d. for good ordinary sorts. With gas coke in small supply, quotations hold firmly at 21s. 6d. for this year's shipments. Patent oven coke is plentiful and in slow demand at from 17s. to 18s., according to shipment dates. Beehive or superior foundry coke is quoted 24s. to 28s.

## SCOTLAND.

*(From our own Correspondent.)*

### More Hopeful Outlook.

THE depression in the steel and iron industries is of such long standing that any movement towards an expansion in demand is almost sufficient to create a feeling of hopefulness. Fair inquiries have been in circulation of late, and now comes the announcement that steel makers in the Motherwell district are to benefit from the placing of a contract for 3000 tons of material for the Burmah Oil Company. This contract has been secured despite keen competition, and it is hoped may be the forerunner of others.

### Steel.

Apart from the order referred to above, new business is very scarce and short time is all too prevalent. Home demands are poor and overseas trade is adversely affected by political and economic conditions in the East, Australia, and South America, as well as by the weakness on the Continent. Orders for heavy steel have not come up to expectations, especially in the case of shipbuilding materials. Lighter descriptions also are none too well placed. Orders for steel tubes of any make are scarce, those for hot rolled being almost as difficult to obtain as those for lap-welded and butt-welded. The recent reduction in the price of sheets has had little effect so far. Specifications generally are scarce and the shortage is specially noticeable in the heavier gauges, which are subject to competition from the steel makers. Galvanised sheets, corrugated 24 g., are now quoted about £11 17s. 6d. per ton, home or export.

### Iron.

If anything, pig iron is the most unsatisfactory department at present. Demands are decidedly weak and the position is complicated by continued importation of competitive material from India and the Continent. The number of furnaces in blast in Scotland at present does not exceed twelve, compared with about eighty in pre-war days. Bar iron and re-rolled steel bars are somewhat neglected. The former suffers from the slackness in the consuming trades, while the latter have to meet severe continental competition. Bar iron is unchanged in price, as are re-rolled steel bars at £7 12s. 6d. per ton, home or export.

### Scrap.

Dealings in scrap are not extensive and prices remain on the recent levels of 62s. 6d. for cast iron machinery and 53s. per ton for heavy steel.

### Coal.

Throughout the past week chief interest has centred around the preparation of a scheme for the regulation, supply and sale of coal in Scotland. The scheme presents many difficulties, not the least being the provision for the apportionment in certain circumstances of a percentage of the price obtained for coal sold for home consumption to a special fund for the assistance of the export branch of the industry. The scheme has been submitted at a meeting of the coalowners' district association, and a period of one week has been given to the owners to express approval. If producers of more than one-half of the output in each district during the six months to December 31st, 1929, fail to support the scheme it will fall to the Board of Trade to formulate proposals of its own. Meanwhile conditions in Scotland show no change. Export business is extremely slow and home requirements are not expanding with the season of the year, as might be expected. Apart from Lanarkshire splints, round coals are freely offered for immediate disposal and can be secured below current prices when a favourable deal is in prospect. Nuts are scarce and firm. Aggregate shipments amounted to 243,031 tons, against 213,525 in the preceding week and 281,608 in the same week last year.

## WALES AND ADJOINING COUNTIES.

*(From our own Correspondent.)*

### The Coal Trade.

CURRENT operations in steam coals continue on a restricted scale, though the inland demand is reported to be a shade improved. Coal exports last week were a little better, which was not unexpected in view of the fact that the average daily number of idle tipping appliances was lower than for some time past. According to the G.W.R. Company returns, shipments last week amounted to 526,100 tons, which compared with 524,000 tons in the previous week, though the total compares unfavourably with the same period of last year, when the quantity was 596,045 tons. The week finished up with twenty-six idle tipping appliances at the leading docks, with three steamers waiting to berth, while as the result of arrivals of tonnage over the week-end, the position on Monday was that eighteen appliances were idle and six steamers were waiting. Chartering operations must, however, expand if the situation is to improve to any extent. So far as contract business is concerned, the only inquiry of any note is that of the Egyptian State Railways for 155,000 metric tons of locomotive coal. This presumably will be for delivery over the first three or four months of 1931. Tenders have not to be in the hands of the railways until December 16th. The current contract is in the hands of the Maris Export and Trading Company, Ltd., and is just expiring. It tendered for 100,000 tons at 26s. 5½d. c.i.f. Alexandria and 40,000 tons at 26s. c.i.f.

### Curtailment of Shipment Facilities.

The proposal of the Great Western Railway Company to curtail the facilities for the shipment of coal, referred to last week, brought a storm of protest from all quarters. The traders have not yet given up the fight, though they have secured a modification of the company's original proposal, which was to suspend entirely the shipment of coal at Bute East Dock, Cardiff, the operation of seven tips at Barry, two at Newport, and one at Port Talbot. The company's main point in proposing this was that owing to the falling off in coal shipments economies were imperative, and the simplest and best method of achieving that object was that in the case of Cardiff a complete unit, like the Bute East Dock, should be closed so far as coal shipments were concerned. The traders put up an equally strong case for the retention of the full facilities, and it was especially pointed out that steamers of 1500 to 3500 tons were mainly dealt with at the Bute East Dock, and being of the self-trimming type received quick despatch. The effect of the company's proposal would be to slow up despatch, throw pressure upon the other docks and cause disadvantages to all interested in the coal export business. Not only did the Cardiff Chamber of Commerce Council, representing the traders, meet the company's officials, but the Parliamentary Committee of the Cardiff Corporation met to consider the position and received a deputation from the National Union of Railwaymen, to which organisation the tippers belong. Conferences were in progress all day last Friday, the company being urged that it should refrain from putting into operation its proposals pending further discussions. The end of it all was that the company modified its scheme to come into force on Monday, the 22nd inst., to this extent that it agreed to keep in operation at the Bute East Dock three berths suitable for accommodating wagons of 20 tons. The traders still complained that this was quite inadequate, and made a strong appeal to Mr. J. Milne, the general manager, to continue the maintenance of full coal-loading facilities, but the general manager declined to make any further concession, though agreeing to meet a deputation of the Chamber of Commerce at Paddington on Wednesday of this week.

### Decreased Traffic Receipts.

The G.W.R. Company has just issued its returns of seaborne traffic for this district, but the figures are far from encouraging. For the four weeks ended August 31st imports and exports came to only 2,324,283 tons, which was 319,840 tons less than the preceding month and 618,623 tons below the total for the corresponding period of last week. The facts that during August iron ore imports for this district only amounted to 29,237 tons, as compared with 120,432 tons for the same month of 1929, shows how quiet the iron and steel industry is in South Wales. Traffic returns for the early part of this year were quite satisfactory, but the falling off in trade during recent months has quite altered the complexion of the statistics. The aggregate figures for the eight months ended August 31st last in respect of imports and exports give a total of 23,989,068 tons, which compares with 25,593,160 tons for the corresponding period of 1929, a decrease of 1,604,092 tons. Coal and coke exports alone amount to 18,769,061 tons, as against 19,862,391 tons, a falling off of 1,093,330 tons. The decline in traffic is for the most part on the export side, as imports for the first eight months were 3,316,538 tons, as against 3,390,978 tons for the same period of 1929. On the other hand, exports came to 20,672,530 tons, as compared with 22,202,182 tons.

### Engineering Contract.

Messrs. Braithwaite and Co., engineers, of Newport, have secured a contract from the South African Railways for bridge spans amounting to £15,000. This order was secured in competition with continental firms, and is for eleven bridge spans of 100ft. each.

### Relief Schemes.

The Public Works Committee of the Cardiff City Council has approved of schemes for the relief of Cardiff's unemployed involving a total expenditure of more than £100,000. The Breconshire County Council has also provisionally approved of the arterial road scheme of the Ministry of Transport — Swansea-Shrewsbury — which affects 16 miles of road in Breconshire. The cost of this portion is estimated at £141,500, and the Ministry offers 85 per cent. grant conditionally on the importation of labour from distressed areas.

### Current Business.

Slow conditions prevail so far as current business is concerned, and the chartering of tonnage is not quite as active as was the case a week or two ago. Notwithstanding the irregularity with which numerous collieries are working, supplies of coal of all descriptions are more than adequate to market requirements. Prices in all sections are at the minima, small coals being more plentiful than for some time past. The patent fuel and coke markets are also quiet, while pitwood, in consequence of the restricted requirements of collieries, remains comparatively dull at 26s. to 26s. 3d.

### Spelter Works.

The works of the English Crown Spelter Company at Swansea are to be closed down for an indefinite period. This is in consequence of the existing low price of spelter, which is stated to be cheaper now than it has been for about thirty years. The closing down of the works will mean that about 400 men will be added to the unemployed list.

## South African Engineering Notes.

### Cape Town City Engineer.

Mr. D. E. Lloyd-Davies, M. Inst. C.E., the Cape Town city engineer, has tendered his resignation from the service of the City Council on the grounds of ill-health. He is, however, remaining in office for a further twelve months, so as to see the completion of the main schemes now in hand, among which may be mentioned the construction of an air port near Maitland, extension of the sewage outfall to the sea at Green Point, the development of the Sea Point foreshore, the new arterial road between Wynberg and Muizenberg, and extensions to the municipal abattoirs. The more outstanding works for which Mr. Lloyd-Davies has been responsible during recent years are the main drainage system for the southern suburbs, costing £800,000; the Steenbras waterworks, £2,500,000; and the reconstruction of the city main roads, £625,000.

### Building Tramcars.

The first of twelve new tramcars was put into service on the Johannesburg tramways on August 11th. The Johannesburg City Council is building these vehicles at a total cost of £42,000. They are double-decked bogie cars. The motors and electrical equipment from overseas were delivered in November, 1929, and the designing and building was done in the Council's workshops. It is expected that three more new cars will be in operation very shortly. The electrical equipment and seats were the only parts imported. All material for the bodies and frames was bought locally. The fittings were cast in the municipal foundry of the electrical department. The tops of these cars are completely closed with glass.

### Madingushi Falls Power Station.

The "Logefor" Company, a subsidiary of the Union Minière du Haut Katanga, has recently completed, adjacent to the Madingushi Falls, a large hydro-electric power station to supply the copper mines. The power is being transmitted at 120,000 volts to Pauda, which is 60 miles distant, where it is distributed to the mines and works in the vicinity. The plant has been successfully tested, and is now in full operation.

### Atmospheric Nitrogen.

The group of industries centred at the Modderfontein Dynamite Factory in the Transvaal Province is continually expanding. Among the activities there is the manufacture of the modern aluminium-cased "Briska" detonators. The factory can make and sell well over 24,000,000 detonators a year, and that is barely half the annual needs of the mining industry of the Union. Of sulphuric acid the works makes no less than 10,000 tons a year, and in the course of a twelve months no less than 60,000 cases of explosives, holding 50 lb. each, are manufactured. This output, together with that of the sister factory at Somerset West, in the Cape Province, far exceeds the total usage of explosives in England, though it is less than that of America. The essential ingredient, sodium nitrate, has to be imported from Chili, which up to recently was the sole source of that chemical for the whole world. A large plant designed by the Imperial Chemical Industries, Ltd., is now being added to the Modderfontein industries, and is to be used for the fixation of atmospheric nitrogen. The plant will cost about £600,000, and will be capable of supplying the whole needs of the Union and Rhodesia for many years to come. As a result, South Africa will be made self-supporting in so far as that major primary product of explosives and fertilisers is concerned.

## PERSONAL AND BUSINESS ANNOUNCEMENTS.

WE are officially informed that Colonel J. B. Neilson, C.M.G., D.S.O., C.A., has been appointed to a seat on the board of Vickers-Armstrongs, Ltd., to fill the vacancy caused by the death of Mr. G. G. Sim.

CROMPTON PARKINSON, Ltd., ask us to state that a rumour, which has been widely circulated amongst their clients and the trade generally, to the effect that they are ceasing the manufacture of switchgear and transformers, is absolutely without foundation.

THE LEA RECORDER COMPANY, Ltd., asks us to announce that its head office and sales department are being moved from 28, Deansgate, Manchester, to Recorder House, Cornbrook Park-road, Manchester. Telephone number, Trafford Park 2077 (three lines); telegraphic and cable address, "Recording, Manchester."

THE JUNIOR INSTITUTION OF ENGINEERS.—The Council of the Institution has made the following award of medals and prizes to members for the session ending September 30th, 1930:—The Institution Gold Medal to H. Southern; the Institution Silver Medal to R. H. Allen; the Vickers Gold Medal and Prize to H. J. N. Riddle; the Dunn Medal (for lectures at informal meetings) to J. G. Hopcraft; the Tookey Award (for papers read at informal meetings) to C. J. Hill. Silver medals have also been awarded to the following members for papers read in local sections:—North-Western Section, G. L. Wolfaston; Sheffield Section, W. R. Gutteridge; North-Eastern Section, T. W. Stewart. The competition for the Durham Bursary resulted in two awards of £25 each being made to T. H. Martin and J. E. Gray.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—The following scholarships have been awarded by the Institution of Electrical Engineers for 1930:—Ferranti Scholarship, annual value £250, tenable for two years: E. Wilkinson, Liverpool University. Duddell Scholarship, annual value £150, tenable for three years: T. R. Stretton, Cardiff Technical College. David Hughes Scholarship, value £100, tenable for one year: H. A. Wainwright, Sheffield University. Salomons Scholarship, value £100, tenable for one year: E. Bell, Armstrong College, Newcastle-on-Tyne. War Thanksgiving Education and Research Fund (No. 1): Grants of £50 each to F. J. Clark, East London College, and Miss W. Hackett, Birmingham University. Thorrowgood Scholarship, annual value £25, tenable for two years: J. F. H. Tyler, Southern Railway Company.

# Current Prices for Metals and Fuels.

## IRON ORE.

| | |
|---|---|
| N.W. COAST— | |
| (1) Native | 17/9 to 20/6 |
| (1) Spanish | 20/6 to 21/– |
| N.E. COAST— | |
| Native | 18/– to 21/– |
| Foreign (c.i.f.) | 19/– |

## PIG IRON.

| | Home. £ s. d. | Export £ s. d. |
|---|---|---|
| (2) SCOTLAND— | | |
| Hematite | 3 18 0 | — |
| No. 1 Foundry | 3 19 0 | — |
| No. 3 Foundry | 3 16 6 | — |
| N.E. COAST— | | |
| Hematite Mixed Nos. | 3 11 0 | 3 11 0 |
| No. 1 | 3 11 6 | 3 11 6 |
| Cleveland— | | |
| No. 1 | 3 6 0 | 3 6 0 |
| Siliceous Iron | 3 6 0 | 3 6 0 |
| No. 3 G.M.B. | 3 3 6 | 3 3 6 |
| No. 4 Foundry | 3 2 6 | 3 2 6 |
| No. 4 Forge | 3 2 0 | 3 2 0 |
| Mottled | 3 1 6 | 3 1 6 |
| White | 3 1 6 | 3 1 6 |
| MIDLANDS— | | |
| (e) Staffs.— | (*Delivered to Station.*) | |
| All-mine (Cold Blast) | — | — |
| North Staffs. Forge | 3 8 6 | — |
| „ „ Foundry | 3 13 6 | — |
| (e) Northampton— | | |
| Foundry No. 3 | 3 10 0 | — |
| Forge | 3 5 0 | — |
| Derbyshire— | | |
| No. 3 Foundry | 3 13 6 | — |
| Forge | 3 8 6 | — |
| (3) Lincolnshire— | | |
| No. 3 Foundry | — | — |
| No. 4 Forge | — | — |
| Basic | — | — |
| (4) N.W. COAST— N. Lancs. and Cum.— | | |
| Hematite Mixed Nos. | 4 3 6 (*a*) / 4 5 6 (*b*) / 4 10 6 (*c*) | — |

## MANUFACTURED IRON.

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| SCOTLAND— | | |
| Crown Bars | 10 5 0 | 9 15 0 |
| Best | — | — |
| N.E. COAST— | | |
| Iron Rivets | 11 10 0 | — |
| Common Bars | 10 15 0 | — |
| Best Bars | 11 5 0 | — |
| Double Best Bars | 11 15 0 | — |
| Treble Best Bars | 12 5 0 | — |
| LANCS.— | | |
| Crown Bars | 10 5 0 | — |
| Second Quality Bars | 8 15 0 | — |
| Hoops | 13 0 0 | — |
| S. YORKS.— | | |
| Crown Bars | 10 5 0 | — |
| Best Bars | 11 0 0 | — |
| Hoops | 12 0 0 | — |
| MIDLANDS— | | |
| Crown Bars | 10 0 0 to 10 7 6 | — |
| Marked Bars (Staffs.) | 12 10 0 | — |
| Nut and Bolt Bars | 9 0 0 to 9 5 0 | — |
| Gas Tube Strip | 11 2 6 | — |

## STEEL. (*d*)

| | (6) Home. £ s. d. | (7) Export. £ s. d. |
|---|---|---|
| (5) SCOTLAND— | | |
| Boiler Plates (Marine | 10 10 0 | 10 10 0 |
| „ „ (Land) | 10 0 0 | 10 0 0 |
| Ship Plates, ½in. and up | 8 15 0 | 7 15 0 |
| Sections | 8 7 6 | 7 7 6 |
| Steel Sheets, ¼in. | 8 15 0 | 8 15 0 |
| Sheets (Gal. Cor. 24 B.G.) | 11 17 6 | 11 12 6 |

## STEEL (*continued*).

| | Home. £ s. d. | Export. £ s. d. |
|---|---|---|
| N.E. COAST— | | |
| Ship Plates | 8 15 0 | 7 15 0 |
| Angles | 8 7 6 | 7 7 6 |
| Boiler Plates (Marine | 10 10 0 | — |
| „ „ (Land) | 10 0 0 | — |
| Joists | 8 10 0 | 7 7 6 |
| Heavy Rails | 8 10 0 | — |
| Fish-plates | 12 0 0 | — |
| Channels | 10 5 0 | £9 to £9 5s. |
| Hard Billets | 8 2 6 | — |
| Soft Billets | 6 17 6 | — |
| N.W. COAST— | | |
| BARROW— | | |
| Heavy Rails | 8 10 0 | — |
| Light Rails | 8 15 0 to 9 0 0 | — |
| Billets | 6 15 0 to 9 10 0 | — |
| MANCHESTER— | | |
| Bars (Round) | 9 7 6 | — |
| „ (Small Round) | 7 12 6 to 7 15 0 | — |
| Hoops (Baling) | 10 0 0 | 9 15 0 |
| „ (Soft Steel) | 9 0 0 | 8 15 0 |
| Plates | 8 17 6 to 9 2 6 | — |
| „ (Lancs. Boiler) | 9 12 6 | — |
| SHEFFIELD— | | |
| Siemens Acid Billets | 9 10 0 (basis) | — |
| Hard Basic | 9 2 6 and 9 12 6 | — |
| Intermediate Basic | 7 12 6 and 8 2 6 | — |
| Soft Basic | 6 10 0 | — |
| Hoops | 9 15 0 | — |
| Soft Wire Rods | 8 0 0 | — |
| MIDLANDS— | | |
| Small Rolled Bars | 7 12 6 to 8 10 0 | — |
| Billets and Sheet Bars | 5 15 0 to 6 5 0 | — |
| Galv. Sheets, f.o.b. L'pool | 11 12 6 | — |
| (2) Staffordshire Hoops | 10 0 0 | — |
| Angles | 8 7 6 | — |
| Joists | 8 10 0 | — |
| Tees | 9 7 6 | — |
| Bridge and Tank Plates | 8 17 6 | — |
| Boiler Plates | 9 10 0 | — |

## NON-FERROUS METALS.

| | |
|---|---|
| SWANSEA— | |
| Tin-plates, I.C., 20 by 14 f.o.b. | 17/– |
| Block Tin (cash) | 131 15 0 |
| „ (three months) | 133 10 0 |
| Copper (cash) | 45 5 0 |
| „ (three months) | 45 7 6 |
| Spanish Lead (cash) | 17 15 0 |
| „ „ (three months) | 17 10 0 |
| Spelter (cash) | 15 10 0 |
| „ (three months) | 15 12 6 |
| MANCHESTER— | |
| Copper, Best Selected Ingots | 50 0 0 |
| „ Electrolytic | 50 10 0 |
| „ Strong Sheets | 77 0 0 |
| „ Tubes (Basis Price), lb. | 0 0 11½ |
| Brass Tubes (Basis Price), lb. | 0 0 10½ |
| „ Condenser, lb. | 0 1 0½ |
| Lead, English | 19 7 6 |
| „ Foreign | 18 0 0 |
| Spelter | 15 15 0 |
| Aluminium (per ton—raw ingot) | £95 |

## FERRO ALLOYS.

| | | |
|---|---|---|
| Tungsten Metal Powder | 2/6 per lb. | |
| Ferro Tungsten | 2/3 per lb. | |
| | Per Ton. | Per Unit. |
| Ferro Chrome, 4 p.c. to 6 p.c. carbon | £23 12 6 | 7/– |
| „ „ 6 p.c. to 8 p.c. | £22 10 0 | 7/– |
| „ „ 8 p.c. to 10 p.c. | £22 0 0 | 7/– |
| „ „ Specially Refined | | |
| „ „ Max. 2 p.c. carbon | £33 10 0 | 10/– |
| „ „ „ 1 p.c. carbon | £38 0 0 | 13/6 |
| „ „ „ 0·70 p.c. carbon | £39 0 0 | 15/– |
| „ „ „ carbon free | 11d. per lb. | |
| Metallic Chromium | 2/7 per lb. | |
| Ferro Manganese (per ton) | £11 15 0 for home | |
| „ „ „ | £11 0 0 for export | |
| „ Silicon, 45 p.c. to 50 p.c. | £11 10 0 scale 5/– per unit | |
| „ „ 75 p.c. | £19 0 0 scale 7/– per unit | |
| „ Vanadium | 12/9 per lb. | |
| „ Molybdenum | 4/2 per lb. | |
| „ Titanium (carbon free) | 9d. per lb. | |
| Nickel (per ton) | £170 to £175 | |
| Ferro Cobalt | 9/6 per lb. | |

## FUELS.

### SCOTLAND.
*Prices not stable.)*

| | Export. |
|---|---|
| LANARKSHIRE— | |
| (f.o.b. Glasgow)—Steam | 12/6 |
| „ „ Ell | 13/6 |
| „ „ Splint | 14/6 to 16/– |
| „ „ Trebles | 13/– |
| „ „ Doubles | 12/6 to 13/– |
| „ „ Singles | 12/– |
| AYRSHIRE— | |
| (f.o.b. Ports)—Steam | 13/– |
| „ „ Jewel | 16/– |
| „ „ Trebles | 13/6 |
| FIFESHIRE— | |
| f.o.b. Methil or Burntisland—Steam | 10/9 to 11/9 |
| Screened Navigation | 16/6 to 17/6 |
| Trebles | 13/6 to 15/– |
| Doubles | 12/6 to 13/6 |
| Singles | 11/3 |
| LOTHIANS— | |
| (f.o.b. Leith)—Best Steam | 11/– |
| Secondary Steam | 10/9 |
| Trebles | 13/– |
| Doubles | 12/9 |
| Singles | 11/6 |

### ENGLAND.

| | |
|---|---|
| (8) N.W. COAST— | |
| Steams | 20/6 to 21/– |
| Household | 32/– to 51/– |
| Coke | 21/– to 22/– |
| NORTHUMBERLAND— | |
| Best Steams | 13/6 |
| Second Steams | 12/– |
| Steam Smalls | 10/– to 10/6 |
| Unscreened | 12/6 |
| Household | 25/– to 37/– |
| DURHAM— | |
| Best Gas | 14/9 to 15/– |
| Second | 12/9 to 13/– |
| Household | 25/– to 37/– |
| Foundry Coke | 24/– to 26/– |

| SHEFFIELD— | Inland. |
|---|---|
| Best Hand-picked Branch | 24/– to 25/6 — |
| Derbyshire Best Bright House | 19/– to 21/– — |
| Best House Coal | 18/– to 19/6 — |
| Screened House Coal | 16/– to 17/– — |
| „ „ Nuts | 14/– to 16/– — |
| Yorkshire Hards | 14/– to 15/6 — |
| Derbyshire Hards | 14/– to 15/6 — |
| Rough Slacks | 8/6 to 9/– — |
| Nutty Slacks | 7/– to 8/– — |
| Smalls | 3/– to 5/– — |
| Blast-furnace Coke (Inland) | 12/6 on rail at ovens |
| Furnace and Foundry Coke (Export), f.o.b. | 17/– to 18/6 |

### CARDIFF— (9) SOUTH WALES.

| | |
|---|---|
| Steam Coals: | |
| Best Smokeless Large | 20/– |
| Second Smokeless Large | 18/9 to 19/9 |
| Best Dry Large | 18/6 to 18/9 |
| Ordinary Dry Large | 17/6 to 18/– |
| Best Black Vein Large | 18/3 to 18/6 |
| Western Valley Large | 18/– to 18/3 |
| Best Eastern Valley Large | 17/9 to 18/– |
| Ordinary Eastern Valley Large | 17/6 to 17/– |
| Best Steam Smalls | 13/6 to 13/9 |
| Ordinary Smalls | 11/6 to 12/9 |
| Washed Nuts | 19/– to 22/– |
| No. 3 Rhondda Large | 20/– to 20/6 |
| „ „ Smalls | 15/6 to 16/– |
| No. 2 „ Large | 17/– to 17/3 |
| „ „ Through | 16/– to 16/6 |
| „ „ Smalls | 14/– to 14/3 |
| Foundry Coke (Export) | 27/6 to 37/– |
| Furnace Coke (Export) | 21/– to 21/6 |
| Patent Fuel | 22/– |
| Pitwood (ex ship) | 26/– to 26/6 |
| SWANSEA— | |
| Anthracite Coals: | |
| Best Big Vein Large | 35/– to 37/6 |
| Seconds | 27/– to 31/6 |
| Red Vein | 23/6 to 27/– |
| Machine-made Cobbles | 41/6 to 45/– |
| Nuts | 40/– to 46/– |
| Beans | 24/6 to 27/6 |
| Peas | 21/– to 21/6 |
| Breaker Duff | 10/– to 10/6 |
| Rubbly Culm | 11/3 to 11/9 |
| Steam Coals: | |
| Large | 19/6 to 21/6 |
| Seconds | 18/– to 19/6 |
| Smalls | 12/– to 13/– |
| Cargo Through | 15/6 to 16/– |

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate: Joists (minimum), 12/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 10/– if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country stations.

# French Engineering Notes.

(*From our Correspondent in Paris.*)

### Steel Production.

THE decision of the Steel Cartel to reduce the steel output by a further 15 per cent. during the last quarter of the year, making a total reduction of 25 per cent., is not to the liking of French steel makers, who have alone been exceeding their quota and have thus incurred penalties which may become extremely irksome if they are unable to keep their production within the new limit imposed. This further reduction had been anticipated for some time, though it was hoped to avoid it, if only as a means of checking the pessimism that pervades the market. The restriction became all the more necessary in consequence of the withdrawal of minimum prices, but values have failed to respond favourably to the lessened production, there being a decline on the week in the quotations for partly manufactured steel and rolled steel sections, while sheets have fallen from 50f. to 150f. a ton. The Franco-Luxemburg Union of Phosphoric Pig Iron Producers has fixed its prices at £2 18s. per English ton f.o.b. Antwerp for Great Britain, and £3 per ton for other overseas markets. This weakening of the steel trade would seem to imply that French producers are running no risk in accepting the new restriction of output, but, as a matter of fact, they do not believe that it is justified by the situation of their own market, for while there has been a continuous falling off in the home demand, the general feeling is one of confidence in an early recovery. A considerable amount of work is being held up pending the financial assistance which the State is preparing to give for the carrying out of public works, and there is promise of a great deal of activity in the Colonies. Should these hopes of a revived demand be realised, French steel makers may, if they adhere to the restricted output, let in a good deal of foreign steel, while, if they produce all that is required at home, they may have to pay a considerable amount in penalties to other countries belonging to the Steel Cartel.

### Railway Signalling.

The method of electric signalling which has been employed for some years past on the suburban sections of the State Railways has proved so completely satisfactory that it is to be adopted throughout the entire French railway system. All the companies have agreed with the Conseil Supérieur des Chemins de Fer that it is desirable to employ uniform signals, and the work of replacing the existing signals will be started next year. As there are something like 60,000 signals to be transformed, it is hardly likely that the work will be completed within a period of less than five years. The arrangement of lights for day and night signalling on the State Railways has been frequently changed as the result of experience, and the method finally adopted is an arrangement of three lights on a triangular black panel, with projecting hoods above the lights. A concentrated light from a dead black background is found to be efficient under all conditions of weather, and it can be seen even when a fog would render a semaphore signal invisible. The white light for a free track is to be replaced by the green light, which is employed in all countries except France, Holland and Spain. It is curious that the French have only now realised the danger of using a white light for safety when other white lights in the neighbourhood may be mistaken for the signal. The other lights to be used are yellow for caution and red for danger. Owing to the confusion that may arise from the changing of colours all the companies will carry out the work simultaneously in stages and arrange it in such a manner as to minimise risk of error, which can be no more serious than to mistake the green for its present signification of caution.

### Miners' Strike.

The threat of a short strike to compel coalowners to pay the men full wages for a yearly holiday is not likely to have much effect, seeing that the colliery companies have agreed to the principle of the claim, though only on condition that it does not involve any reduction in the output per man. The owners are taking a firm stand on what is regarded as a vital point. There can be no question of adding to the cost of coal-getting at a time when British coal prices in this country are lower, when wages have been reduced in Belgium and the German coalowners have notified a termination of the present wages' scale, and especially when the stocks of coal in all continental producing countries are increasing considerably. The falling prices of industrial coal in Belgium and Germany are making the situation more and more difficult. French coalowners, therefore, declare that while agreeing to the principle of paying wages for the miners' holidays, there must be no reduction in the number of working hours, and the eight hours must be a daily average over the whole year, so that the production can be adjusted to a fluctuating demand.

### Road Construction.

The forthcoming Road Congress at Washington is regarded with special interest by French engineers, who believe that the information there collected will enable them to come to a definite conclusion upon the system of road construction most suitable for this country. Apart from tarred macadam construction little has been done on the French country roads, except some stretches of concrete road, and the question to be decided now is whether the roads of the future are to be of tarred macadam or concrete. An experimental stretch of concrete road between Bailleul and Cassel has proved quite satisfactory under arduous conditions of traffic and climate. This material appeals to road engineers because it avoids the necessity of importing enormous quantities of tar products and the upkeep is less costly, but more is required to be known about the methods of cheapening the methods of concrete road construction, and it is hoped that this will be forthcoming at the Washington Congress.

# British Patent Specifications.

*When an invention is communicated from abroad the name and address of the communicator are printed in italics.*

*When an abridgement is not illustrated the Specification is without drawings.*

*Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.*

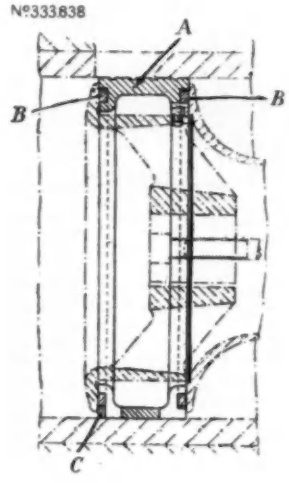
*The date first given is the date of application; the second date, at the end of the abridgement, is the date of the acceptance of the complete Specification.*

## STEAM ENGINES.

333,838. November 28th, 1929.—MEANS FOR PACKING PISTONS, J. M. D. Wrench, Government of India Railway Department (Railway Board), Secretariat Buildings, New Delhi, British India.

This packing ring appears to have been specially devised for the piston valves of steam locomotives. The ring A is split

N°333,838



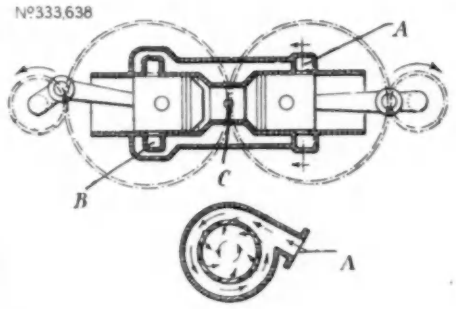

to allow for its expansion against the walls of the valve chamber. It is, however, restrained from unusual expansion by the two solid rings B B. At the point where the ring A is cut, there is a tongue C, which fills the opening and prevents the passage of steam.—*August 21st*, 1930.

## INTERNAL COMBUSTION ENGINES.

333,638. May 21st, 1929.—TWO-STROKE ENGINES, H. R. Ricardo, 21, Suffolk-street, Pall-mall, London, S.W. 1.

This engine is of the opposed-cylinder two-stroke type, with a common combustion chamber and has two crank shafts. The air for combustion is admitted to one cylinder in a tangential manner at A, and the exhaust takes place from the other cylinder

N°333,638



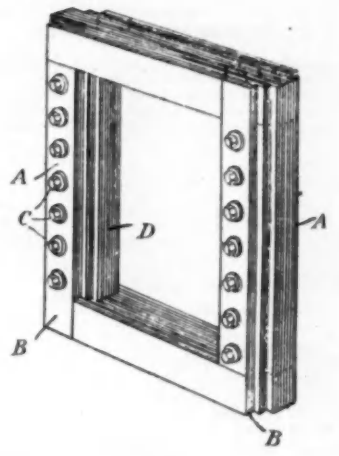

at B. The fuel is injected into the combustion chamber at C. By means of setting the cranks of the two shafts at different angles, as shown in the drawing, the incoming charge of air is pushed from one cylinder to the other before it is finally compressed, and in this way it is most thoroughly intermingled with the fuel spray. It will be noted that the two crank shafts are interconnected by gearing.—*August 21st*, 1930.

## TRANSFORMERS AND CONVERTERS.

317,830. August 23rd, 1929.—MAGNETIC CORES, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2.

The layers or laminations, or, at least, some of them, for very large transformer cores, are so wide that it is difficult to anneal them properly and to handle them without injury while they are being shaped, during the annealing process and while they are being assembled. The laminations of a large core generally have bolt holes punched in them and are held together by bolts passing through these holes. The bolts interfere with the easy handling of the wide laminations, which are apt to be bent and injured as they are assembled over the bolts. The general object of the invention is to provide an improved arrangement of laminations for large cores which may be easily annealed and assembled. The magnetic core includes two laminated winding legs connected at their ends by laminated yokes. Each winding leg A is built up of laminations of different widths, the narrower ones being outside, so that the leg approximates a cylindrical shape to fit inside the windings which surround it in the completed transformer. The narrower outside laminations B may not be too wide to anneal and handle conveniently without danger of injury to them, and these are shown in the drawing as being formed in the usual way, each comprising a single magnetic sheet having a row of holes punched in it for the bolts C. The wider inside laminations D, however, are each formed in two longitudinal sections. Each lamination has a central row of bolt holes corresponding in position and spacing to the bolt holes in the narrower outside laminations B. The joint between the two sections of each wide lamination D extends along one edge of its row of bolt holes, which are formed as notches in the inner edge of the wider section of the lamination. In some of the laminations, the joint between the two sections is at one side of the row of bolt holes, and in the other laminations this joint is at the other side of the bolt holes, so that

N°317,830

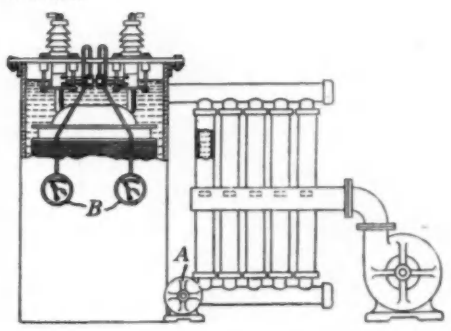



the positions of the wider and narrower sections of some of the laminations are reversed laterally from their positions in the other laminations. The inner edges of the wider sections of the laminations thus overlap between the bolt holes and are pressed tightly together and held in place by the bolts C.—*August 21st*, 1930.

318,202. August 12th, 1929.—ELECTRICAL TRANSFORMER COOLING SYSTEMS, *Associated Electrical Industries, Ltd., of Bush House, Aldwych, Westminster.*

This invention provides for pumping oil through the radiators of a transformer at a higher rate than it would naturally flow by the action of gravity, and, therefore, increases the heat-dissipating capacity of the radiators. Further cooling means

N°318,202




A are provided for forcing a cooling medium, such as a draught of air, about the outer surface of the radiators, thereby increasing the amount of heat transferred from the radiators to the surrounding air. The invention also provides a number of forced-cooling systems, each of which is controlled by thermally responsive devices B, actuated at different predetermined temperatures of the oil in the transformer tank.—*August 21st*, 1930.

## TELEGRAPHS AND TELEPHONES.

312,272.—May 17th, 1929.—IMPROVEMENTS IN SIGNALLING CABLES, *Siemens-Schuckertwerke Gesellschaft mit beschrankter Huftung (in liquidation), of Berlin-Siemensstadt, Germany.*

In the case of a trunk line cable with double quad-stranding, it is possible to realise a definite proportion between the quad-capacity and the pair-capacity by arranging insertions between the two conductors of each pair, whilst the twisting together to form a quad is carried out in the usual manner. According to this

N°312,272

Fig. 1

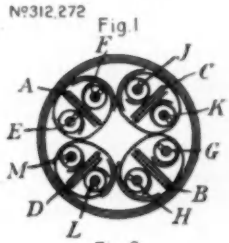
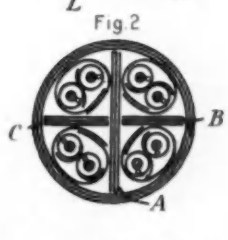



Fig. 2



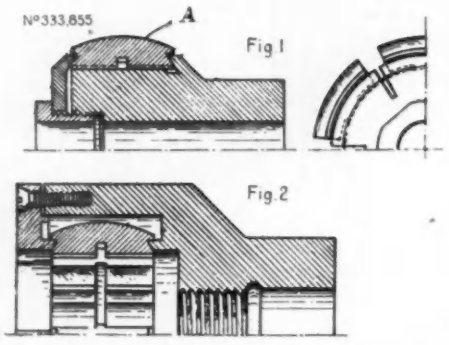

invention, it is proposed to use this process in trunk line cables, with double quad-stranding. Such a double quad consists of four pairs of wires twisted together in common about an axis, each two opposite pairs of wires being grouped into a quad. With this arrangement the desired proportion of the quad-capacity to the pair-capacity can be attained by arranging insertions A, B, C, and D respectively between the two wires E and F, G and H, J and K, and L and M of each pair, as shown

in Fig. 1. Between the pairs of wires themselves such insertions are not in this case provided. Instead of increasing the proportion of the quad-capacity to the pair-capacity, it may be necessary in certain cases to lower this proportion. In this connection, it is possible, as shown in Fig. 2, to twist together the individual pairs of wires without insertions and to provide between the individual pairs of wires corresponding insertions A B C.—*August 18th*, 1930.

### TRANSMISSION OF POWER.

333,855. January 30th, 1930.—BEARINGS, Aktiebolaget Noury, Z. Norrmalstorg, Stockholm, Sweden.

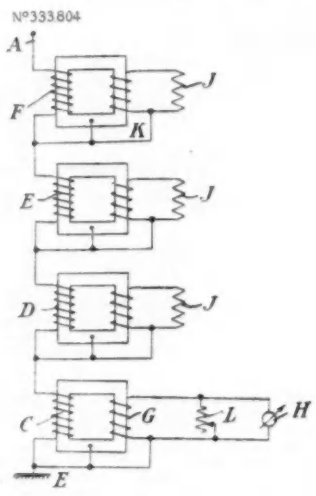
This invention is concerned with journal bearings of the pad, or Michell, type. It is pointed out that the pads, after hardening, should all be ground together to secure the best results in running. The inventors use two fittings for holding the pads while they are being ground. In Fig. 1 is shown the device for holding the pads, one of which is seen at A, while the exterior is being ground. Fig. 2 illustrates the fixture for grinding the interior.—*August 21st*, 1930.




### MEASURING AND TESTING INSTRUMENTS.

333,804. October 21st, 1929.—DEVICES FOR MEASURING HIGH VOLTAGES, International General Electric Company, Incorporated, of 120, Broadway, New York.

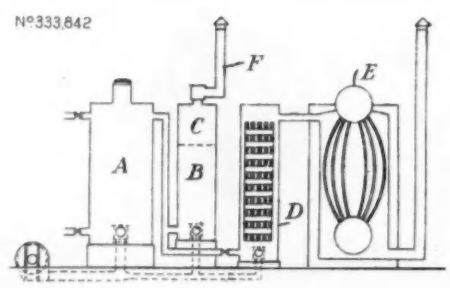
In accordance with this invention, a set of series connected transformers is used for the measurement of high voltages, of which one only is a true voltage transformer. The voltage to be measured is that between the point A and earth. The high-voltage windings C to F of four voltage transformers are connected in series. Of the low-voltage windings, that G of the transformer situated nearest to earth feeds the measuring instruments H, while the others are loaded with ohmic resistances J. In parallel to the instruments H a regulating resistance L can be arranged and suitably adjusted so that the loads of all the transformers may be equal. The iron core and secondary circuit of each transformer are connected with one point of the high-voltage winding through the leads K. The transformers have then to be insulated for the voltage ruling at that point. A good arrangement is to set up all the transformers, one above the other, in the form of a pillar, with interspaced insulators, and thus a measuring device is obtained in the form of a vertical column of insulators over the height of which the voltage is subdivided in equal stages.—*August 21st*, 1930.




### GAS PRODUCERS.

333,842. December 2nd, 1929.—WATER GAS GENERATORS, A. Breisig, 46, Erdbrustgasse, Vienna XVI, Austria.

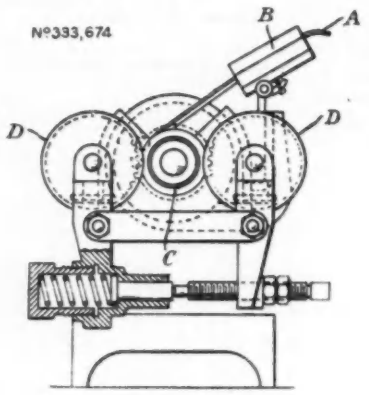
The object of this invention is to reduce the size of a waste-heat boiler used in connection with a water-gas making plant, by arranging for its continuous heating. In the drawing the generator is shown at A, the superheater at B, and the carburetter at C. There is also a recuperator at D. During the "blow" period of working, part of the gas made passes through the recuperator and thence to the boiler E. The remainder escapes up the stack F. During the steaming period the gas made is also passed through the recuperator and serves as a means of transferring the heat stored there to the boiler.—*August 21st*, 1930.




### MISCELLANEOUS.

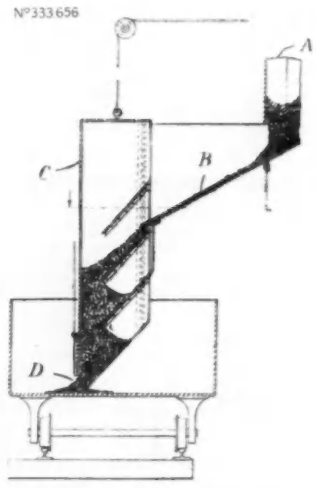
333,674. June 6th, 1929.—MAKING FLEXIBLE METALLIC TUBING, *J. H. Beaumont*, 201, *Bank Chambers*, 329, *High Holborn, London, W.C.* 1.

This is a most extensive specification and describes a machine for making helical tubes from strip metal, in detail. The strip A is first passed through a fixed die B, which turns up its edges. It is coiled on to a mandrel C, and the edges are folded further by the rotating discs D D. It is then forced through a hollow die with a helical channel to compact the joints.—*August 21st*, 1930.



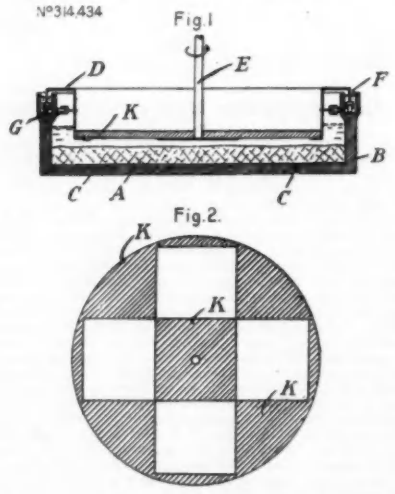

333,656. May 27th, 1929.—APPARATUS FOR LOWERING COAL, COKE, &c., H. Adams, 934, Park-avenue, Plainfield, New Jersey.

The object of this invention is to minimise the breakage of coal, and suchlike materials, in the process of loading them by gravity. The coal is supplied from a hopper A and flows down the inclined shoot B into the auxiliary hopper C. This hopper is provided with a series of sloping floors, on to which the coal is flowed, and it is discharged into the wagon or boat through the opening D. The sizes of the apertures are so proportioned that there is always a suppy of coal in the auxiliary hopper, and the hopper is gradually raised as the wagon is filled, to reduce the free fall of the coal to a minimum.—*August 21st*, 1930.




314,434. June 26th, 1929.—PRODUCING METAL SHEETS BY ELECTROLYTIC MEANS, Ernst Kelsen, of 16, Michaelerstrasse, Vienna XVIII, Austria.

This invention relates to apparatus for the electrolytic production of metal sheets. The anode material A, in the form of pieces, is disposed in a layer of uniform depth on the bottom of the tank B and is connected with the current supply by carbon rods C, let into the bottom of the tank. D is the lid of the tank, the disc-shaped centre portion of which is so recessed that it dips under the hot electrolyte in the tank. The lid is fixed on a shaft E, which is set into rapid rotation by a suitable drive and runs in a water seal F, around the edge of the tank. Rollers G serve for guiding the lid. The surface of the disc-shaped recessed metal portion is provided with a suitable deposition base, which facilitates the detaching of the deposit and by means of insulated surfaces K, which are indicated in Fig. 2 by hatching, the deposition base is subdivided so that sheets of rectangular form are obtained.—*August 21st*, 1930.




## Forthcoming Engagements.

*Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the* TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY AND SATURDAY, SEPTEMBER 27TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Southern District meeting at Southampton. Friday: 10 a.m., assemble at Audit House. Official welcome by the Mayor of Southampton, Mr. Councillor H. Young. Description of works by Mr. S. G. Stanton, Borough Engineer and Surveyor and Housing Architect. 11 a.m. to 1 p.m., visits to various works being carried out by the Corporation. 1.30 p.m., arrive at South-Western Hotel for lunch by the invitation of the Mayor and Corporation. Saturday: 9.30 a.m., assemble at South-Western Hotel. Discussion on paper, "Municipal Undertakings." 11 a.m., inspection of Southern Railway Company's new dock works, Western Esplanade. 1 p.m., luncheon at South-Western Hotel. 3 p.m., assemble at the Ocean Dock, Entrance No. 2 Gate, Southampton Docks, for an inspection of R.M.S. "Majestic."

TO-DAY TO SUNDAY, SEPTEMBER 28TH.

NATIONAL SMOKE ABATEMENT SOCIETY.—Second Annual Conference at Leicester.

TO-DAY TO WEDNESDAY, OCTOBER 1ST.

BUILDING TRADES EXHIBITION.—At Olympia, London.

WEDNESDAY, OCTOBER 1ST.

ENGINEERING GOLFING SOCIETY.—Autumn meeting on the course of the Burhill Golf Club, Walton-on-Thames. 10 a.m.

THURSDAY, OCTOBER 2ND.

BRITISH ASSOCIATION OF REFRIGERATION.—Presidential address by Sir Wm. B. Hardy. 5.30 p.m.

FRIDAY, OCTOBER 3RD.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. "The Development of the Bridge," by Mr. S. J. Crispin. 7.30 p.m.

SATURDAY, OCTOBER 4TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—College of Technology, Sackville-street, Manchester. Presidential address by Mr. R. W. Stubbs. 4 p.m.

TUESDAY, OCTOBER 7TH.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—Chamber of Commerce, New-street. T. G. Bamford, M.Sc. Chairman's address. 7 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Royal Society of Arts, John-street, W.C. 2. "The Future Trend of Automobile Design," Presidential address of Sir Herbert Austin. 8 p.m.

WEDNESDAY, OCTOBER 8TH.

ILLUMINATING ENGINEERING SOCIETY.—E.L.M.A. Lighting Service Bureau, 15, Savoy-street, W.C. 2. "A Report on the Progress of Illuminating Engineering." 6.30 p.m.

INSTITUTION OF CHEMICAL ENGINEERS.—Chemical Society, Burlington House, W. 1. "The Effect of Surface Conditions on Heat Transmission," by Mr. Saral J. Kohli. 8 p.m.

THURSDAY, OCTOBER 9TH.

INSTITUTE OF METALS: LONDON LOCAL SECTION.—Rooms of the Society of Motor Manufacturers and Traders, Ltd., 83, Pall Mall, S.W. 1. W. T. Griffiths, M.Sc. Chairman's address. 7.30 p.m.

INSTITUTION OF WELDING ENGINEERS.—The Engineers' Club, Albert-square, Manchester. "The Training of Operators in the Welding and Cutting Industries," by Mr. J. Ryder. 7.45 p.m.

ROYAL AERONAUTICAL SOCIETY.—Royal Society of Arts, John-street, W.C. 2. "The Growth of Aviation." Inaugural address by the President, Mr. C. R. Fairey. 6.30 p.m.

FRIDAY, OCTOBER 10TH.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—Non-ferrous Section of the Applied Science Department of the University, St. George's-square. Conjoint meeting for the sixth "Sorby" Lecture. 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. "The Refining of Cane Sugar," by Mr. S. Dunlop. 7.30 p.m.

SATURDAY, OCTOBER 11TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH, BURNLEY SECTION.—Technical College, Omerod-road, Burnley. "Belgian Moulding Sands in the Ironfoundry," by Mr. F. Griffiths.

MONDAY, OCTOBER 13TH.

INSTITUTE OF TRANSPORT.—Institution of Electrical Engineers, Victoria Embankment, W.C. 2. Inaugural address by the President, the Hon. Sir Arthur Stanley. 5.30 p.m.

TUESDAY, OCTOBER 14TH.

INSTITUTE OF METALS: NORTH-EAST COAST LOCAL SECTION.—In the Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne. Mr. C. Gresty. Chairman's address. 7.30 p.m.

MANCHESTER GEOLOGICAL AND MINING SOCIETY.—Engineers' Club, Albert-square, Manchester. Annual dinner. 6.15 p.m.

WEDNESDAY, OCTOBER 15TH.

ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY.—Northampton Institute, Clerkenwell, E.C. 1. "Practical Difficulties in the Electro-deposition of Chromium," by J. W. Cuthbertson. 8.15 p.m.

INSTITUTION OF ENGINEERING INSPECTION.—Rooms of the Royal Society of Arts, John-street, W.C. 2. "A Practical Application of British Standard Limits and Fits to Locomotive Construction," by Mr. E. Harle. 5.30 p.m.

FRIDAY, OCTOBER 17TH.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. "The London Automatic Telephone System," by Mr. T. H. Flowers. 7.30 p.m.